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THE UNIVERSITY OF ALBERTA

DEPENDENCY AND KNOWLEDGE OF RESULTS

IN PROGRAMMED INSTRUCTION

by

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A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES

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FACULTY OF GRADUATE STUDIES

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies for acceptance, a thesis entitled Dependency and Knowledge of Results in Programmed Instruction, submitted by Walter Muir in partial fulfillment of the requirements for the degree of Master of Education.



## ABSTRACT

The present study has attempted to investigate the relationship between dependency motivation and two schedules of knowledge of results in programmed instruction.

Dependency motivation is described in the literature as being based on interpersonal relationships. It was postulated, therefore, that students who are identified as highly dependency motivated will not achieve as well in programmed instruction as low dependency motivated students, due to the restriction of interpersonal contact imposed by the program. The results of the study indicated that highly dependent students tended to achieve at a higher level than non-dependents. It was concluded that redefinition of the theoretical construct of dependency motivation should be made which emphasizes the need of the dependent individual to have maximum feedback, regardless of whether the object of the dependency is human or otherwise.

There is evidence in the literature to suggest that students who learn under a schedule of partial knowledge of results will have retained more of the learned material at a delayed testing, while not differing on immediate recall, than students who learn under continuous knowledge of results. The study indicated that, initially, those students who learn under a partial schedule are hindered by a lack of feedback, but are gradually able to utilize contextual cues and, thereby, achieve equally with those having continuous knowledge of results. The suggestion that retention is facilitated by partial knowledge of results was not supported.

An interactional trend, in which highly dependent students achieved higher on continuous knowledge of results and low dependents on the partial schedule, is suggested.





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## CHAPTER I

### INTRODUCTION

The effectiveness with which programmed instruction is able to assist the learner in acquiring knowledge is well documented. Current research is seldom directed toward comparisons between traditional teaching methods and the new technology. Instead, new and improved programs and programming techniques are being tested with a view to obtaining a maximum efficiency of learning for program users. An inspection of the available literature on programmed instruction indicates, however, that there are at least two researchable areas in which very few studies have been conducted.

Although programmed instruction has been studied and used widely for over 10 years, the personality characteristics of the learner, as he functions in the programmed instructional setting have been virtually ignored. B. F. Skinner, the man generally recognized as the "father" of programmed instruction, has provided little suggestion that there exist any real differences between the learning of pigeons, with which he first developed his principles of operant conditioning, and that of humans, to which those same principles have been, perhaps too easily, generalized. Verbal learning, as practised by humans, is vastly more complex than the motor learning of lower animals. The human organism, itself, is much more variable than any other species and therefore would be



expected to exhibit greater variability in learning potentialities.

One purpose of this study is to investigate the influence of one seemingly relevant personality trait, dependency motivation, on the effectiveness of learning via programmed instruction.

A second somewhat neglected aspect is that of schedules of knowledge of results as related to both the acquisition and retention of programmed material. Experimental psychologists such as Jenkins and Stanley (1950), Lewis (1960), Festinger (1961) and Skinner (1963), have illustrated the effectiveness of delayed and partial reinforcement in building a resistance to extinction in animal learning. Very little has been done, however, to investigate a similar effectiveness with regard to human verbal learning in a programmed sequence. A second purpose of this study, then, is to investigate the influence of schedules of knowledge of results on the acquisition and retention of programmed material.

In addition, the interaction, if any, between the level of dependency and schedule of knowledge of results will be scrutinized. Concomitant measures such as I.Q., age, socio-economic status, previous learning, time spent in learning, and errors committed will also be considered.





## CHAPTER II

### RELATED LITERATURE

#### Dependency

Definition. "Dependency is one of the most significant, enduring, and pervasive qualities of human behavior. From birth to old age, it influences the form and quality of all dyadic relationships." (Sears, 1963, p. 25). Bandura and Walters (1963, p. 39) define dependency as a "class of responses that are capable of eliciting positive attending and ministering responses from others." Cairns (1961) views dependency as relating generally to the class of interpersonal responses in which one person seeks the help, approval and company of others.

Edwards (1959) bases his description of dependency on the manifest needs of Murray (1938). To Edwards, the needs of nDeference, nSuccorance, and nAutonomy describe the individual on a dependence-independence continuum. Heathers (1955b, p. 277) suggests that "a person is dependent on others to the extent that he has needs which require that others respond in particular ways if these needs are to be satisfied. A person is independent of others to the extent that he can satisfy his needs without requiring that others respond to him in particular ways." The interpretation of "needs" in this context is similar to that of Murray.

Heathers describes two major forms of dependency; instrumental and emotional. Instrumental dependency is present when a person seeks help in





reaching goals. Emotional dependency arises when the responses of others are the goals rather than the means of reaching them. Among the latter would be the demands for reassurance, affection, and approval. Heathers considers independence to be the obverse of dependence. Instrumental independence describes the person who conducts activities and copes with problems without seeking help. Emotional independence refers to the relative absence of needs for reassurance, affection, and approval.

Bernardin and Jessor (1957) in their construct validation of the Edwards Personal Preference Schedule support the suggestion that the two variables, nDeference and nAutonomy, appear to be related to the definition of dependency. They also consider dependence-independence to be unidimensional.

Sears and his fellow workers, (Sears 1963, Sears, Maccoby & Levin 1957, Sears, Whiting, Nowlis, & Sears 1953), regard dependency as a learned motivational system in which help-seeking and approval-seeking are the primary manifestations.

Flanders, Anderson and Amidon (1961) define what they choose to call dependence-proneness as a continuum from strong need for support and reassurance, to a desire to be left alone.

Hartup (1963, p. 333) suggests that the term dependency "covers a wide variety of behaviors all of which are directed toward the satisfaction derived from contact with, or nurturance from, other people." Hartup indicates that self assertion is one aspect of independence which does not



have a counterpart in dependence and which, therefore, would imply that dependence-independence is not completely unidimensional. That is, independence in this respect should be defined as something more than the lack of dependence.

Beller (1955, p. 26) also argues against the bi-polarity of dependence-independence when he states that, "whereas dependency was derived conceptually from association of the parent and parental behavior with drive reduction, independence is here conceived as developing from the association, in the child's experience of his own behavior, with drive reduction when he begins to explore and manipulate the environment."

The definition which most adequately describes the form of dependency to which this study is addressed is that of emotional dependency as defined by Heathers (1955b). The suggestion that "independence" is more than the lack of dependency is not germane to this study.

Development of Dependency. The inability of the infant to function autonomously forces him to depend on his original caretakers. His early needs are essential to his existence and hence his behavior is directed toward their satisfaction. Dependency behavior directed toward satisfaction of primary needs or instrumental dependency as it is called by Heathers (1955b), is originally a biological necessity. If it persists beyond the age at which the child is capable of performing many or most of his own survival tasks it will be manifest in help seeking demands. Since this type of behavior is not culturally acceptable it usually decreases in frequency as the child grows older, but may be replaced by less obvious,







but equally dependent appeals for attention or reassurance. When dependency behavior does persist, Bandura and Walters (1963, p. 162) suggest that it may do so because the "reward of dependency responses increases dependency behavior, whereas the punishment of dependency behavior appears to reduce its incidence, except when intermittent rewards are also supplied". They also suggest that the combination of punishment and reward for dependency behavior may result in even higher degrees of dependent behavior than when only rewards are given.

The prolonged withholding of rewards for dependency, on the other hand, leads to a decrease in dependency behavior. McCord, McCord, and Verden (1962) suggest that early and severe emotional deprivation leads to decreased dependent strivings in the child. However, once the minimum conditions for socialization are established, dependent behavior appears to be increased by general emotional frustration. That is, parental punishment which is specifically directed against dependent behavior tends to increase the dependent behavior of the child.

Hartup (1958) studied the effects of nurturance and nurturance-withdrawal on preschool children. His hypothesis was that non-nurturance by an adult is more strongly associated with the occurrence of dependency behavior in young children than is nurturance alone. He found uniform support for the hypothesis with regard to girls. However, while there was no overall significance in the case of boys, Hartup found that those boys who were identified as highly dependent behaved similarly to the girls in exhibiting dependency behavior. He suggests that boys who are not overtly dependent



might have sex identification in advance of the dependent boys.

An alternative use of the term dependency is as a motivational construct. This definition is perhaps more useful than the behavioral construct for it seems to describe, more logically, the pervasive quality that Sears (1963) alludes to above.

There are several writers who include the motivational construct in their definition of dependency. For example Heathers (1955b), speaks of emotional dependence, and Bandura and Walters (1963) refer to person-oriented dependency. Both Beller (1955) and Cairns (1961) are more explicit when they use the term, generalized dependency drive. Flanders, Anderson, and Amidon (1961), have introduced the term dependence-proneness.

The development of dependency motivation in the child, of course, also has its roots in the early relationship between mother and child when dependence responses are necessarily reinforced during the first year or two of life. "On the other hand, independence training also commences early and results in the partial inhibition of dependency behavior. Thus the conditions for a conflict in the area of dependency are present very early in the life of every child." (Jakubczak and Walters, 1959, p. 102)

Beller (1955, p. 27) suggests five aspects of parent-child relations that might be considered components of a "dependency drive;" (a) physical contact, (b) proximity, (c) attention paid, (d) help given, (e) recognition, ie. parental approval and praise. He feels that "overprotection will reinforce dependence and interfere with development of independence drives. Through excessive help and contact, the parent will prevent the child from





experiencing drive reduction in association with his own activity."

According to Sears (1963) certain satisfying aspects of the nurturant relationship between mother and child become secondary rewards or reinforcers. Expectancies are set up in the child as responses to signals from the mother. These are essential to his chaining of responses into purposeful units of activity. Should the mother fail to perform as expected, however, the baby will suffer frustration. "The development of mutual expectancies molds the mother and baby into a dyad, a unit which can operate effectively only so long as both members perform their accustomed roles in expected fashion". (Ibid, p. 31)

Sears suggests that a dependency drive emerges if the mother occasionally fails to reward, or even punishes, dependent appeals by the child. Dependency then, acquires motivational properties as a result of the ensuing conflict. Experimental evidence is provided to support this hypothesis.

A number of studies in addition to that of Sears (1963) have attempted to test various hypotheses regarding the development of dependency, e.g. Stendler (1954), Sears, Whiting, Nowlis and Sears (1953), Sears, Maccoby and Levin (1957), McCord, McCord and Verden (1962), Siegel, Stolz, Hitchcock and Adamson (1959). Most, if not all of these studies may be criticized as to methodology. The nursery schools associated with various universities provide the subjects in a majority of instances and consequently the generality of results must be limited. Reliability of time-sample observations and parent reminiscences leaves the measurement aspect open to question. These deficiencies notwithstanding, there does





appear to be a consensus regarding the influence of reward for dependence, and the kind and amount of frustration experienced by the child.

The stability of emotional dependence has been studied by Heathers (1955a), Stith and Connor (1962) and Kagan and Moss (1960). They found in general, emotional dependence on adults declines with age relative to dependence on other children. Clinging and affection seeking behavior were also found to decline with age relative to approval seeking. Heathers favors the interpretation that, in the process of socialization, emotional dependence tends to shift away from infantile dependence on adults toward a more active and assertive dependence on peers. Stith and Connor (1962) found no sex differences, whereas Kagan and Moss (1960) found greater stability of dependent behavior in females, a reflection, they suggest of social acceptability.

There are three studies by McCandless and his colleagues, (Marshall and McCandless 1957, McCandless, Bilous and Bennett 1961, McCandless and Marshall 1957), which investigate dependency behavior and social acceptance. All studies used preschool children as subjects. The findings suggest a negative relationship between dependency scores and measures of social acceptance. The writers conclude that dependence on adults in the pre-school situation accompanies relatively low social status and participation.

Two studies (Zuckerman and Grosz 1958, and Jacubczak and Walters 1959), investigated the relationship between suggestibility and dependency. Both indicate that a person who is suggestible is likely to have strong



dependency needs.

In summary, the persistence of dependency in the growing child appears to be closely related to the quality of parent-child relations and, to a lesser extent, the frequency of parent-child contacts. Hartup (1963, p. 350) in reviewing the published literature on dependency, states that the findings generally suggest that frustrations experienced during infancy are associated with later dependency manifestations.

Measurement of Dependency. Much of the research on dependency has been based upon ratings of overt behavior and the recollection, by parents, of their child rearing practices. There are many contaminating factors associated with such measures and hence their reliability must be suspect. Livson and Mussen (1957), in attempting to explain the lack of a predicted relationship between dependency and ego control, state that dependency is inherently difficult to observe and measure under free observation. Low inter-observer reliability is given as evidence of this fact. Invariably, the studies which have used preschool and nursery school children have employed observational and parent report techniques.

Attempts to objectify measures of dependency have been based largely on Murray's (1938) taxonomy of needs. The Thematic Apperception Test (Murray, 1943) uses a set of pictures which show various social situations. The testee is encouraged to describe what he sees in each picture and therefore, "projects" or ascribes his needs and drives to subjects or objects in the outer world. "According to the psychoanalytical





hypothesis concerning projection, this mechanism is employed for the defense of the ego against unacceptable forces and is, at least in part, unconscious". (Bellak, 1951, p. 3). While a guide for scoring the TAT protocol is provided, much of the evaluation of the "underlying dynamics" falls to the individual scorer, and, hence, a degree of subjectivity is introduced.

Zuckerman and Grosz (1958) found a significant relationship between nurses' nSuccorance scores on the TAT and "high swayers" on the "Sway Test". This, they felt, indicated that a person who is suggestible would have high dependency needs. Similarly, Kagan and Mussen (1956) administered the TAT to college students who were then asked to express their opinion as to the relative length of two lines after three "stooges" had previously expressed their falsified opinions. The subjects who produced TAT themes in which the hero sought help in a problem situation, or was portrayed as disturbed over loss of love and support, (ie. nSuccorance), yielded to the incorrect majority more frequently than those subjects not writing these types of stories.

An objective measure of Murray's (1938) manifest needs was developed by Edwards (1959). The Edwards Personal Preference Schedule presents the testee with 255 paired statements. He is expected to select that statement of each pair which he thinks best describes himself. Social desirability of response is controlled by presenting statements which are considered to be equal in that respect. Of the 15 scores available on the EPPS, three are considered to describe a





unidimensional dependence-independence factor; nDeference, nAutonomy and nSuccorance. Norms are provided for males and females in college and adult categories. Bernardin and Jessor (1957), and Cairns and Lewis (1962), have provided evidence to support the validity of the EPPS.

Flanders, Anderson and Amidon (1961) describe the development of a scale of dependence-proneness. They administered a battery of 150 items to 1200 eighth grade students. The items were set in the social context of either peer relationships or adult-child relationships. Item themes referred to help seeking, succor, affection, affiliation, conformity, compliance, and approval seeking. The original 150 item battery was reduced to the 45 best discriminating items by item analysis.

Dependency and Achievement. Studies that investigate the relationship between dependency and academic achievement are few in number and are hampered by a sundry of methodological problems.

"A review of literature relating personality to discrepant achievement indicates, with few exceptions, the lack of a theoretical orientation which would adequately account for those variables influencing achievement", (Taylor, 1964, p. 76). There are however, several studies which may be used as guide lines for an investigation into this little traversed area.

Crandall, Preston, and Rabson (1960) hypothesized that dependent children are apt to rely more on other persons and less on their own resources. Such children are less likely, therefore, to find occasions to develop achievement skills or to experience satisfactions for



independent accomplishments. The study attempted to assess the relationships between independence and achievement development in young children and to evaluate the antecedents of achievement behavior. Their subjects were 30 nursery school children of the Fels Research Institute. The experimental group of 19 boys and 11 girls were rated over a three week period on a time-sample basis. Evaluations of each child were made on: (a) achievement striving, (b) help seeking, (c) emotional support seeking, (d) approval seeking. Previous to this, each child had been observed in his own home in interaction with his mother.

The major findings of the study were, that direct maternal rewards of children's achievement behavior are predictive of children's achievement striving outside the home and that high achieving children are less dependent than low achievers. Children who exhibited achievement efforts at home, did so at school. There were no sex differences in either achievement or dependency behaviors. Mothers who rewarded achievement behavior were less apt to reward dependent behavior. Independence training and the rewarding of achievement behavior were found to be positively related.

McClelland (1953, p. 293) appears to support the findings of Crandall et al. when he states that "...independence training is most nearly related to what we have been calling achievement training. A child, who is forced to be 'on his own' ....is one who will have to master his own problems and get along by himself. Furthermore, parents who stress independence are likely to stress self-reliance and individual achievement".





Winterbottom (1958, p. 478) studied the themes of 29 boys, 8 - 10 years old, as they responded to Thematic Apperception Test pictures. These, she compared to the mother's attitude toward, and practice during, independence training and found that the earlier demands for independence training were made by the mothers of boys relating high nAchievement themes on the TAT pictures. These mothers were also more frequent and more effective in their rewards of achievement behavior. Winterbottom concludes "that early training in independence and mastery contributes to the development of strong achievement motivation".

Endsley and Hartup (1960) defined dependency as seeking praise from the teacher. They studied nursery school children and hypothesized that dependency is one determinant of level of performance on socially reinforced tasks. They measured "persistence" and "rate of response" on a simple repetitive motor task and found that, when responses were verbally reinforced by the teacher, those children judged to be highly dependent performed with more persistence and with greater speed than those judged to be low dependent. This finding would suggest that achievement striving on the part of dependent children is contingent on the availability of social reinforcers. The task itself would conceivably be of relatively less importance than the praise received from an adult for the dependent child, whereas the less dependent, or independent child would be somewhat disinterested in both.

Amidon and Flanders (1961) studied the effects of "direct" and "indirect" teacher influence on 140 "dependence-prone" eighth grade



students. The subjects were selected on the basis of their scores in the highest quartile on the Flanders, Anderson and Amidon scale of dependence-proneness (1961, p. 580). A laboratory design was used in which the same teacher, using the two approaches mentioned, taught a sequence of basic geometry concepts to the students in each experimental group. The students in the "indirect" teaching group scored significantly higher than those in the "direct" teaching group. The inference to be gained from these results lies in the characteristics associated with each teaching method. The "direct" group was not permitted to ask questions, seek clarification or make suggestions, as was the "indirect" group. The "indirect" group received a considerable amount of praise and encouragement whereas the "direct" group received virtually none. It would seem to follow that the dependent-prone student achieves at a higher rate when maximum contact with a significant other is maintained. As the teacher becomes more directive, the dependent-prone student will find increased satisfaction in more compliance, often with less understanding. Only when the dependent student is free to express his doubts, to ask questions and gain reassurance, does his understanding keep pace with his compliance to the authority figure.

Three studies have attempted to determine the relationships between personality measures and college achievement. Morgan (1952) obtained scores on the Strong Vocational Interest Blank, MMPI, and TAT for groups of achieving and non-achieving college students who had previously scored high on aptitude measures. He found that the academic





achievement of high-ability students was related to, maturity and seriousness of interests, awareness of and concern for others, sense of responsibility, dominance, persuasiveness, self confidence, and motivation to achieve. These categories tend to describe the independent personality.

Middleton and Guthrie (1959) studied 14 high achieving and 14 low achieving business management students. They administered a 300 item personality questionnaire made up of items drawn from Murray (1938). The questionnaire was factor analyzed for each group. A factor which loaded positively on autonomy, aggression, and achievement but negatively on affiliation was derived from the high achievers. Low achievers provided a factor which loaded negatively on autonomy. The sample size, however, is hardly adequate for a factor analytic study and the results can only be considered with this fact in mind.

Holland (1959) studied the relative predictive ability of the California Personality Inventory (CPI) and the Scholastic Aptitude Test (SAT) on the achievement of 1321 Merit winners. The group was subdivided according to sex and to science or non-science orientation. It was further divided to provide for a cross-validation group. The correlations obtained were generally of a low order, although the large numbers in each category resulted in many coefficients achieving significance. For boys, sociability, self-acceptance, responsibility, socialization, social presence, flexibility, and self control attained predictor status. For girls, only social presence and socialization were significant.





Achievement via independence did not reach a significant level, contrary to Gough's (1957) hypothesis. However, this failure, it is suggested, could well be a reflection of the highly restricted range of academic achievement of the sample. The writers conclude that the inclusion of the CPI in the regression analysis resulted in significant increases in predictive efficiency.

### Schedules of Reinforcement

A reinforcement is any environmental event which, upon its occurrence, strengthens the behavior it follows. With regard to automated teaching devices, a reinforcement results directly from the learner's behavior and is usually in the form of confirmation of the correct response.

"We might say that the human organism is reinforced by any simple gain in competence. When we guarantee a consistent gain by breaking the material to be learned into small steps, we raise the frequency of reinforcement to a maximum and reduce aversive consequences to a minimum." (Skinner, 1961, p. 9)

According to Skinner (1963), reinforcement may be contingent upon four conditions: 1. the occurrence of a response, 2. special features of the topography of the response, 3. the presence of prior stimuli, and 4. the scheduling systems associated. It is the last condition with which we are here concerned.



Continuous reinforcement obtains when each correct response is reinforced. However, since continuous reinforcement rarely occurs in nature, we must also consider the more common situation where reinforcements occur on an intermittent basis. "Partial reinforcement refers to reinforcement given at least once but omitted on one or more of the trials or after one or more of the responses in a series." (Jenkins and Stanley, 1950, p. 194)

The scheduling of partial reinforcement refers to the frequency of occurrence of successive reinforcements. In the area of learning, four schedules of reinforcement are generally considered. They are: 1. fixed interval, 2. variable interval, 3. fixed ratio, and 4. variable ratio. The first two mentioned refer to the time elapsing between successive reinforcements. Since, in programmed instruction each student learns at his own rate, such temporally based reinforcement schedules are not generally applicable. The latter two schedules, however, refer to the number of responses between reinforcements and are, therefore, relevant to the programmed learning situation.

Fixed ratio reinforcement describes the situation where every  $n^{\text{th}}$  response is reinforced,  $n$  being a constant. Variable ratio reinforcement implies that, while the proportion of reinforcements over a large number of responses is a constant, the reinforcement varies, usually on a random basis, over a relatively small segment of the learning sequence.

According to Amsel (1960), Skinner has failed to provide many of the essential guiding principles for his theory of programmed





instruction. Skinner is accused of too easily moving from experiments with pigeons to the teaching of humans by implying that the parameters associated with the former apply equally to the latter. The transfer of principles is not that simple. Amsel questions whether schedules of reinforcement can be employed as a condition of training in the gradual acquisition of a fairly complex skill or knowledge. He concludes that, according to Skinner, they are not applicable because, "the same response is not recurring as in the case of building up rate of responding or persistence of responding of a simple instrumental response". (Amsel, 1960, p. 513). The distinction then, is between the shaping of complex behavior on the one hand and the building of rates of responding and persistence, or nonreward tolerance, on the other.

Amsel states, however, that schedules of reinforcement may be important to programmed instruction in two respects: 1. to maintain an optimal level of operation of the device, and 2. to increase the persistence of the behavior once it has been shaped. One of the recognized problems associated with small-step, highly cued, linear programs is monotony and boredom, particularly in brighter students, with an associated reduction in learning efficiency. In view of this, it would seem desirable to consider the relative effectiveness of scheduling reinforcement in the programmed instructional setting.

Jenkins and Stanley (1950, p. 230) in their review of the literature on partial reinforcement to that date, indicate that, "the most striking aspect of the data is the far greater resistance to



extinction found in partial reinforcement as compared to continuous". While most of the studies they reviewed were related to animal behavior, they feel that the findings generalize to humans.

Lewis (1960) has updated the review of Jenkins and Stanley with a summary of five studies which support the view that partial reinforcement improves resistance to extinction. They indicate that four of the five studies suggest an inverted "U" relationship when percent of reinforcement is plotted against resistance to extinction. The optimum range was found to lie between 30% and 80% reinforcement. With regard to the scheduling of reinforcement, variable ratio appeared to provide the greatest resistance to extinction. However, the writers found little evidence in support of this condition.

Relatively few studies in the literature have been directed toward the effects of partial reinforcement on achievement in programmed instruction. In the only review available, Krumboltz (1961) has described the recent literature on a single page of his article.

Chansky (1960, 1964) used college students in child psychology. The Ss were asked to learn age expectancies of level of social maturity according to one of four schedules of reinforcement: 1. continuous information, (correct response), 2. intermittent information, 3. continuous grading, (right or wrong), 4. intermittent grading. He found that, while acquisition was fastest under continuous information, this condition resulted in the poorest retention. Intermittent information was found to be the most efficient condition, having the second fastest





acquisition and best retention. The author suggests that "the data support the hypothesis that high retention is a function of knowledge of progress..." (Ibid, 1964, p. 100). While the material was not formally programmed, it seems reasonable to consider the presentation very similar to that of a linear sequence.

Krumboltz and Weisman (1962b) investigated the effect of intermittent confirmation in programmed instruction. Four levels of fixed ratio (100%, 67%, 33%, 0%) and two levels of variable ratio (67%, 33%) confirmation were employed. The subjects, 121 college students in Educational Measurement, were administered programmed materials in that content area. Using post-test achievement scores, no significant difference was found either on the basis of percent of confirmation or ratio type. The writers did not administer a retention test and suggest that such a measure, administered two weeks later, might have shown an advantage to intermittent reinforcement.

Fiks (1964) presented three short programs (20 frames) to visitors to a State Fair and he found that the lower educated Ss preferred greater confirmation with the higher educated Ss preferring less. The degree of confirmation (0%, 50%, 100%) was not significant on an immediate achievement test.

There is another aspect of reinforcement scheduling which might be considered in the programmed instruction situation. According to Renner (1964), recent experiments in delay of reinforcement have linked delay of reward to theories of partial reinforcement.





Festinger (1961, p. 5) supports this suggestion by Renner in stating that "partial reward and delay of reward clearly involve the same psychological processes." He argues from his theory of dissonance reduction that the requirement of greater effort during acquisition will lead to increased resistance to extinction. Accordingly it is the added effort imposed by partial or delayed reinforcement during acquisition that is the crucial variable influencing resistance to extinction. In support of his hypotheses, Festinger describes an experiment employing rats running a maze. He found that comparisons between the total number of unrewarded trials showed highly significant differences, with the greater resistance to extinction being associated with the greater number of unrewarded trials.

Renner (1964, p. 355) reports that the majority of studies investigating delay of reinforcement on human learning have dealt with performance on simple motor tasks. The consensus of findings indicates that delayed knowledge does not interfere with motor learning. No mention is made of the facilitating effects, if any, of delay.

Experiments involving verbal learning are few in number and are somewhat contradictory. Saltzman (1951) employed a verbal maze as the learning task and found that learning was slower under delay. Bourne (1957) investigated concept formation as a function of delay of information feedback and found similarly that performance decreased at a positively accelerated rate as  $\log_2$  delay increased.



Brackbill and Kappy (1962) studied 70 third grade boys in a two-choice discrimination task. The objects, such as television sets, were familiar to the boys and were presented under three fixed interval schedules of delay: 0, 5, and 10 seconds. Included also were two retention intervals: one day and eight days. The investigators found no significant differences in time to acquisition. However, length of delay of reinforcement was highly significantly related to retention as measured by: (a) recognition errors, (b) number of relearning trials, and (c) number of errors during relearning. The 10 second delay schedule produced the greatest retention after both one day and eight days.

These writers make a very cogent remark which seems particularly applicable to learning in the programmed instructional setting.

In an experimental study of delay of reinforcement, if the subjects under investigation are capable of producing and making use of distinctive response-produced cues and if the experimental task and procedure are such as to allow the Ss to make use of these cues, then (a) the potentially deleterious effects of delay on learning efficiency will be reduced by virtue of a bridging or mediating effect from criterional response to reinforcement, and (b) retention, or resistance to extinction will be enhanced in proportion to the extent that distinctive response-produced cues have been utilized during acquisition. (Ibid, p. 17)

Covert verbalizations, therefore, mediate the delay of reinforcement and the learner is forced to search for the internal cues that will implicitly provide the necessary reinforcement. The writers close their article with the suggestion that the effect of delayed reinforcement should be studied in the teaching machine setting.





Lumsdaine (1963, p. 619) echoes the comment by Brackbill and Kappy by stating that "in general, differences in the ways that knowledge of results functions have not been clearly analyzed..., particularly in verbal learning."

### Mode of Response

Of real interest to the users of programmed instruction is the efficiency of learning, that is, amount of learning per time spent. Various devices of presentation require differing modes of responding by the learner. Hardware, such as that of Skinner (1961, p. 10) requires a written response, whereas the Crowder (1960, p. 297) Autotutor requires only the pushing of a button. The emergence of the relatively inexpensive programmed text book has permitted users the choice between overt (written) and covert (thinking of the answer) responding. Most programmed texts leave clearly defined spaces in which the response may be written. However, it is usually economically desirable to re-use such a program and consequently, most learners are requested to not write in the booklet but rather to answer covertly, thereby obviating the need for additional materials. If it can be determined which of these two response modes provides for the most efficient learning, it would seem desirable to use it, particularly in an experimental setting.

A number of studies have been directed toward investigating the effect of varying response mode. Of the several articles mentioned here,



only one Krumboltz and Weisman, (1962a) reports findings which support overt (written) responding.

Wittrock (1963) studied first and second grade children. The program was presented by means of slides and a tape recording. One group was required to respond vocally (overt group) while the other did not (covert group). An interaction between mental age and response mode was found. The writer concluded that higher IQ students seem to learn as well under either mode whereas lower IQ students require overt responding for optimal learning to occur.

Keislar and McNeil (1962) compared two matched groups of 99 primary school children on a programmed unit in physical science. They found no significant difference between the two groups on post-test achievement.

Evans, Glaser and Homme (1960) using a symbolic logic program assessed immediate and retention effects of variations in response mode. Learning time was significantly less for the covert group, whereas criterion performance was not significantly different.

Goldbeck and Campbell (1962) report two experiments that investigate response mode. In the first, seventh grade subjects were assigned to one of three response conditions (overt, covert, and reading), and one of three levels of difficulty as defined by the amount of internal cueing in each frame. An interaction effect was found in which the overt group achieved significantly better at the intermediate difficulty level, but less well at the easy and most difficult levels. Efficiency scores ranked reading, covert and overt response modes in that order, however, inspection of the

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reported data indicates little difference between the efficiency of the reading and covert modes.

The second experiment was similar to the first but included an optional mode where the learner could write his response if he was "sure" of its correctness or otherwise reveal the correct answer if he was not. Again, the reading mode proved to be the most efficient with the covert mode following closely.

Stolurrow and Walker (1962) presented a program on descriptive statistics to college students. They found no reliable differences on learning or retention measures between overt or covert responding groups. However, the mean times to completion of the program were highly significant in favor of the covert group. They conclude that covert responding is more efficient under the experimental conditions.

Unruh (1962) also supports the suggestion that covert responding results in optimum efficiency.

Fiks (1964), mentioned above, found no differences in learning between overt, covert and reading modes. However, the subjects, most of whom had not previously encountered programmed learning, seemed to have a more favorable attitude toward the overt response situation.





## CHAPTER III

### THEORETICAL FRAMEWORK

In view of the relative lack of research in the field under investigation, the present study must be considered more empirical than theory-derived. It should be possible, however, to generate a number of testable hypotheses if findings can be linked together.

#### Dependency

The development of dependency and its relative stability across age groups has been reasonably well documented by Sears (1963), Bandura and Walters (1963), Hartup (1958) Heathers (1955a, 1955b), Beller (1955), Stith and Connor (1962), Kagan and Moss (1960), and others.

The possibility of obtaining meaningful objective measures of dependency has been shown by a number of writers such as: Murray (1943), Edwards (1959), and Flanders, Amidon, and Anderson (1961). Differences in achievement striving between dependent and independent children have been studied by Crandall, Preston, and Rabson (1960), Winterbottom (1958), Endsley and Hartup (1960), Amidon and Flanders (1961), and Middleton and Guthrie (1959). Morgan (1952) and Holland (1959) have found that college achievement is related to maturity, sociability, dominance, persuasiveness and other traits which tend to describe the independent individual.



Woolman (1964, p. 4) has made the point clearly that the auto-instructional program attempts to ignore the fact that the classroom is a social system. Each student becomes a relative isolate inasmuch as the positive elements of the student-teacher relationship are greatly reduced.

### Postulate I

The relative inability of the student to appeal to the teacher for reassurance and support will result in a reduced learning efficiency for the dependent student. Therefore, the greater the dependency motivation of the student, the less effectively he will learn in the programmed instructional setting.

### Schedules of Knowledge of Results

Festinger's (1961) suggestion that learning under partial and delayed reward conditions results in greater effort expended by the learner, which in turn leads to greater resistance to extinction, encourages one to seek a cognitively based explanation for this phenomenon.

Brackbill and Kappy (1962) refer to the utilization, by the learner, of response produced cues in verbal learning sequences. The bridging effect of these cues increases retention in proportion to the extent that such cues have been used. In the programmed instructional setting, this approach would describe increased resistance to





extinction under schedules of partial knowledge of results as a function of the learner's ability to utilize the internal cueing and redundancy inherent in the programmed material. The increased expenditure of effort would then, according to Festinger (1961), result in an increment in resistance to extinction when partial schedules are compared to continuous knowledge of results.

### Postulate II

Whereas immediate post-test achievement would not be expected to differ significantly, students who have learned under the condition of partial knowledge of results should retain significantly more of the programmed content as measured by a retention achievement test, than those students who have learned with continuous knowledge of results.

### Interaction Between Dependency and Schedules of Knowledge of Results

The literature provides no indication as to what interactional effects might be predicted when dependency motivation and schedules of knowledge of results are studied in combination. In the absence of such guidance, there seems to be no reason to predict an interaction between amount of dependency motivation and schedule of knowledge of results.



## Hypotheses

The hypotheses which might logically be derived from these postulates are presented here.

### Postulate I

1. Those students who are identified as highly dependency motivated will achieve at a lower level on an immediate post-test based on a programmed instructional sequence than will those students who are identified as being less dependency motivated.
2. Those students who are identified as highly dependency motivated will achieve at a lower level on a retention post-test based on a programmed instructional sequence than will those students who are identified as being less dependency motivated.

### Postulate II

3. Students who have completed a programmed instructional sequence under a schedule of partial knowledge of results will not differ in achievement, when measured by an immediate post-test, from similar students who have learned under continuous knowledge of results.
4. Students who have completed a programmed sequence under a schedule of partial knowledge of results will achieve at a higher level, when measured by a retention post-test, than will similar students who have learned under continuous knowledge of results.

Hypotheses

The hypothesis which might logically be derived from these

postulates are presented here.

Postulate I

1. Those students who are identified as highly dependent  
motivated will achieve at a lower level than an individual  
post-test based on a programmed instructional sequence who  
will those students who are identified as being less  
dependency motivated.
2. Those students who are identified as highly independent  
motivated will achieve at a lower level than a retention  
post-test based on a programmed instructional sequence who  
will those students who are identified as being less  
dependency motivated.

Postulate II

3. Students who have completed a programmed instructional sequence  
under a schedule of partial knowledge of results will not achieve  
in achievement, when measured by an immediate post-test, than  
similar students who have learned under continuous knowledge of  
results.
4. Students who have completed a programmed sequence under a schedule  
of partial knowledge of results will achieve at a higher level,  
when measured by a retention post-test, than will similar  
students who have learned under continuous knowledge of results.



## CHAPTER IV

### METHOD AND EXPERIMENTAL DESIGN

#### Introduction

It was decided to test the hypotheses on a sample of fifth grade students. The bases for this decision were twofold: the nature of the dependency scale required a developmental level at which unguarded responses could be reasonably assured and, the availability of a series of programs which paralleled the Alberta elementary science curriculum and which would, therefore, complement the ongoing learning of the subjects. Added to this was the observation that very few studies in the field of programmed instruction had been conducted in the elementary school and it seemed desirable to attempt to add to the research evidence at this level.

It seemed desirable, also, to design a study which would provide cross-validated support for its findings. Consequently, the students were provided with a single, compact booklet which contained three complete programmed units. The first two programs were considered to constitute replicated experimental treatments while the third program was provided to permit additional, but unrelated learning for the faster learners.

The experiment was conducted during May and June of 1965. The learning period occupied approximately 30 - 40 minutes per day for 11 school days. Testing sessions required an additional four days.





## The Programs

Description. The programs used were developed by the Division of Educational Research, University of Virginia, at Charlottesville, as part of a longitudinal study on the effectiveness of programmed instruction at the elementary school level. The Science Tutor was reproduced locally with the written permission of Dr. W. D. Hedges, director of the division. In its present form, the Science Tutor comprises units in Sound, Light, and Weather. The content covered by these units closely approximates that listed in the Alberta curriculum for grade six science. (Daniels, 1963, pp. 94-97, 106-109). An example of the program is to be found in Appendix A.

The reading level of the programs is that of the fourth grade. A short dictionary of technical terms is provided at the back of each program.

The programs are composed of small step, highly cued, linear sequences. Branching, in the form of frames skipped over, is provided on the basis of the learner's performance on short sub-tests following each logically related sub-section of the program. There are a number of simple experiments which the learner is encouraged to undertake in an effort to promote "discovery" learning.

Two forms of the programs provide either 100 percent or  $33\frac{1}{3}$  percent knowledge of results. The  $33\frac{1}{3}$  percent schedule is variable ratio.

The units on Sound, Light and Weather contain 331, 446, and 381 frames respectively.



Presentation of the Programs. The order of presentation was the same for all subjects. Sound was given first, then Light. The unit on Weather was used to accomodate those who finished in advance of the last subject to complete Light. The subjects were instructed to respond covertly by "saying" the responses silently to themselves, and, to write the correct response to any which had been answered incorrectly. Supplementary ruled paper was provided for the writing of incorrect responses. A tabulation of these entries was used to provide an error count. Time spent on each of the experimental programs was calculated to the nearest five minutes.

The subjects were informed that they were being presented with a new way of learning science. No explicit statement of the experimental aspect of the learning situation was made in an effort to relate the task as closely as possible to the regular classroom procedure. The subjects were told that they might ask questions of either the teacher or the writer at any time.

### The Dependency Scale

Development. The lack of a published instrument that would objectively measure dependency in elementary school children necessitated the development of one by the writer. Two scales purporting to measure dependency were modified slightly and administered to 90 fifth grade students in May of 1964. The first scale by Neville (1955) was composed of 20 weighted multiple choice items. The second scale contained 45 binary





choice items as reported by Flanders, Anderson and Amidon (1961). The items from both tests were pooled and subjected to item analysis and factor analysis. On the basis of the consistency between the two analyses, a 30 item scale composed of 10 items of the Neville scale and 20 items of the Flanders, Anderson and Amidon scale was produced. (See Appendix B). Only items which indicated a negligible sex bias were retained.

Validity. An attempt to obtain evidence of construct validity of the dependency scale was undertaken during the course of the experiment. In accord with the definition of dependency motivation as enunciated by Heathers (1955b), and Flanders, Anderson and Amidon (1961), all appeals for assistance, reassurance, and approval by the subjects were recorded. A significant correlation between score on the dependency scale and number of appeals was obtained. ( $r = .319$ ,  $df\ 62$ ,  $p < .01$ ).

It might, therefore, be assumed that the dependency scale was measuring, at least in part, that which it was designed to do.

Reliability. Two types of reliability were sought: internal consistency, as measured by the Kuder-Richardson Formula 20, (Ferguson, 1959, p. 280), and test-retest reliability. The internal consistency measures were .609 on the first administration and .678 on the second administration. The test-retest reliability, with a three week period between testings, resulted in a correlation of .747.

Scoring. The total score on the dependency scale was considered to indicate a measure of the dependency motivation of each subject.



This score was composed of the sum of the weighted responses. Since the scale was composed of items showing a minimum of sex bias, a single key was used in scoring.

### The Criterion Tests

Two criterion tests were developed, one for Sound and one for Light. Both were multiple choice instruments which attempted to adequately sample the material being taught by the programs. A test blueprint, conforming to Bloom's (1956) taxonomy of educational objectives, was used as a guide to item development.

The first edition of each test was used to evaluate previous knowledge in the specific area and also to test immediate retention. Item responses on the immediate post-test administrations formed the basis for an item analysis of the tests. A revised and expanded edition of each test was used to measure delayed retention.

A table of the descriptive statistics associated with the various administrations of the Criterion tests is in Appendix C. Samples of the final form of the tests are to be found in Appendix D.

### Subjects

The total fifth grade of the Queen Alexandra Elementary Public School, Edmonton, were the subjects in this experiment. The school was arbitrarily assigned, the only condition attached to its assignment being that it serve a district that was essentially mid socio-economic





in nature. In this regard a mean value of 49.70 on the Canadian Occupational Scale, (Elley, 1961), indicated that the Canadian occupational mean of 50.0 was closely approximated.

There were a total of 64 subjects in the sample, with 31 and 33 respectively, in two co-educational classrooms. Thirty-one of the subjects were girls and 33 were boys. The mean age of the subjects was 132.1 months, with a standard deviation of 6.9. Table I contains additional information that is descriptive of the sample.

### Statistical Procedures

The general approach to the statistical treatment of the data was that of multiple linear regression analysis as described in Bottenberg and Ward (1963). This is a relatively new approach to hypothesis testing which incorporates the generalized forms of the analyses of variance and covariance. Specifically, the analysis of covariance approach was employed to permit the inclusion of relevant control variables. The IBM-7040 computer at the University of Alberta was used extensively in the analysis of the data.

### Procedure of the Experiment

Every effort was taken to ensure a consistency of administration between the two classrooms. Except for the initial testing, which occupied the first two days of the experiment, all sessions were held in the morning and varied from 30 to 40 minutes in duration. Each class



TABLE I  
MEANS AND STANDARD DEVIATIONS  
OF COVARIATE AND CRITERION DATA  
FOR TOTAL SAMPLE (N=60)

Variable	Mean	Standard Deviation
1. Lorge-Thorndike Verbal IQ	114.15	13.88
2. Lorge-Thorndike Non-verbal IQ	109.80	15.38
3. Age (months)	132.10	6.91
4. Socio-economic status	49.70	6.82
5. STEP Science (4A)	41.87	8.13
6. Dependency Scale (1st admin.)	38.18	6.17
7. Dependency Scale (2nd admin.)	38.42	6.56
8. Sound-Time (min.)	107.75	26.35
9. Sound-Errors	8.18	8.57
10. Sound-Pretest	9.62	2.30
11. Sound-Immediate Post-test	13.12	3.82
12. Sound-Retention Post-test	13.80	4.31
13. Light-Time (min.)	123.67	34.56
14. Light-Errors	9.22	11.00
15. Light-Pretest	10.13	3.35
16. Light-Immediate Post-test	15.38	4.92
17. Light-Retention Post-test	15.68	5.23

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had a complete set of materials and worked independently of the other, thus permitting an investigation into the possible influence of the classroom teacher in the functioning of programmed instruction.

The dependency scale and the Sequential Test of Educational Progress, Science, Form 4A (1957), were administered on day one. The pretests on Sound and Light were administered in that order on the second day.

The subjects were divided by sex and assigned randomly to one of the two schedules of knowledge of results, (treatments). The assignment was made by the use of a table of random numbers.

On his completion of each of the experimental units, each subject was presented with the appropriate test to obtain a measure of immediate retention. Exactly two weeks after the last subject had completed the unit on Light, a delayed retention test for Sound and one for Light was administered. In the discussion that follows, the immediate retention tests will be referred to as Immediate, whereas the delayed retention tests will be referred to as Retention. A second administration of the dependency scale followed the completion of the experimental units.

Additional covariate data such as, verbal and non-verbal intelligence as measured by the Lorge-Thorndike Intelligence Tests Level 3, Form A, (1954), age recorded in months, and socio-economic status, were obtained from the cumulative records of each subject.



## CHAPTER V

### RESULTS AND DISCUSSION

#### Descriptive Statistics

Complete data was obtained for 62 of the 64 subjects who began the experiment. Incomplete data resulted from a lengthy illness in one case and from a departure from the school in the other. In order that a balance between sexes in each treatment group might be maintained, two subjects were randomly deleted from the sample. Therefore each treatment group contained 15 boys and 15 girls for computational purposes.

Table II provides evidence supporting the adequacy of the random assignment of subjects into the two treatment groups. In all but two instances, the values of "t" fail to reach significance. The differences in pretest achievement might reflect either biases with regard to previous learning in the specific content area or, more reasonably, the relatively low internal consistency of the pretests.

In an effort to determine if, in fact, learning had taken place, a "t" test for correlated samples, (Ferguson, 1959, p. 138), was calculated between pre-test and immediate post-test achievement. The outcome, reported in Table III, indicates that learning did, indeed, occur.

Sex Differences. Since sex differences are usually of interest, the various obtained measures were submitted to tests of "t" between

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10.20

10.21

10.22

TABLE II  
MEANS, STANDARD DEVIATIONS, AND  
t TESTS FOR TREATMENT GROUPS

Variable	100% K of R (N=30)		33 $\frac{1}{3}$ % K of R (N=30)		t <sup>a</sup>
	Mean	S.D.	Mean	S.D.	
1. L-T Verbal IQ	116.60	14.99	111.70	12.20	1.365
2. L-T Non-verbal IQ	111.80	17.07	107.80	13.18	0.999
3. Age	131.80	7.49	132.40	6.26	0.331
4. SES	50.89	7.09	48.50	6.32	1.356
5. STEP Science	41.60	9.16	42.13	6.94	0.250
6. Depend. Scale (1st)	37.93	6.89	38.43	5.35	0.309
7. Depend. Scale (2nd)	37.93	5.56	38.90	7.40	0.562
8. Sound- Time	110.33	26.42	105.17	26.03	0.750
9. Sound- Errors <sup>b</sup>	11.17	10.12	15.60	15.54	1.288
10. Sound- Pretest	8.97	2.56	10.27	1.77	2.248*
11. Sound- Immediate	13.80	3.53	12.43	3.96	1.386
12. Sound- Retention	14.87	4.27	12.73	4.07	1.946
13. Light- Time	119.33	26.61	128.00	40.53	0.963
14. Light- Errors <sup>b</sup>	11.53	12.91	20.70	24.13	1.804
15. Light- Pretest	11.07	3.03	9.20	3.40	2.206*
16. Light- Immediate	16.27	5.30	14.50	4.32	1.391
17. Light- Retention	16.60	5.17	14.77	5.12	1.357

<sup>a</sup>two tailed test, d.f.=58

<sup>b</sup>errors on 33 $\frac{1}{3}$ % K of R tripled to provide comparability.

\*p < .05



# Journal of the

Date		Place		Remarks	
Jan 1	1880	Wash D.C.	Arrived	Left at 10 AM	1
Jan 2	1880	Wash D.C.	Left	Arrived at 10 PM	2
Jan 3	1880	Wash D.C.	Left	Arrived at 10 PM	3
Jan 4	1880	Wash D.C.	Left	Arrived at 10 PM	4
Jan 5	1880	Wash D.C.	Left	Arrived at 10 PM	5
Jan 6	1880	Wash D.C.	Left	Arrived at 10 PM	6
Jan 7	1880	Wash D.C.	Left	Arrived at 10 PM	7
Jan 8	1880	Wash D.C.	Left	Arrived at 10 PM	8
Jan 9	1880	Wash D.C.	Left	Arrived at 10 PM	9
Jan 10	1880	Wash D.C.	Left	Arrived at 10 PM	10
Jan 11	1880	Wash D.C.	Left	Arrived at 10 PM	11
Jan 12	1880	Wash D.C.	Left	Arrived at 10 PM	12
Jan 13	1880	Wash D.C.	Left	Arrived at 10 PM	13
Jan 14	1880	Wash D.C.	Left	Arrived at 10 PM	14
Jan 15	1880	Wash D.C.	Left	Arrived at 10 PM	15
Jan 16	1880	Wash D.C.	Left	Arrived at 10 PM	16
Jan 17	1880	Wash D.C.	Left	Arrived at 10 PM	17
Jan 18	1880	Wash D.C.	Left	Arrived at 10 PM	18
Jan 19	1880	Wash D.C.	Left	Arrived at 10 PM	19
Jan 20	1880	Wash D.C.	Left	Arrived at 10 PM	20
Jan 21	1880	Wash D.C.	Left	Arrived at 10 PM	21
Jan 22	1880	Wash D.C.	Left	Arrived at 10 PM	22
Jan 23	1880	Wash D.C.	Left	Arrived at 10 PM	23
Jan 24	1880	Wash D.C.	Left	Arrived at 10 PM	24
Jan 25	1880	Wash D.C.	Left	Arrived at 10 PM	25
Jan 26	1880	Wash D.C.	Left	Arrived at 10 PM	26
Jan 27	1880	Wash D.C.	Left	Arrived at 10 PM	27
Jan 28	1880	Wash D.C.	Left	Arrived at 10 PM	28
Jan 29	1880	Wash D.C.	Left	Arrived at 10 PM	29
Jan 30	1880	Wash D.C.	Left	Arrived at 10 PM	30
Jan 31	1880	Wash D.C.	Left	Arrived at 10 PM	31

TABLE III  
 TESTS OF  $t$  BETWEEN PRETEST  
 AND IMMEDIATE POST-TEST ACHIEVEMENT  
 (N=60)

	Pretest		Immediate Post-test		$r$	$t^a$
	Mean	S.D.	Mean	S.D.		
1. Sound	9.62	2.30	13.12	3.82	.296	8.87*
2. Light	10.13	3.35	15.38	4.92	.688	13.04*

<sup>a</sup>one tailed test, d.f.=59

\* $p < .0001$



mean values for girls and boys. The results of these comparisons may be seen in Table IV.

It will be noted that the girls were significantly younger than the boys and that they scored higher on both administrations of the dependency scale. The explanation for the age difference is the well documented fact that girls achieve better than boys in school, for various reasons, and we would therefore, expect to find a greater proportion of accelerated girls and, coincidentally, decelerated boys, in any given classroom.

The higher level of dependency motivation of girls, as measured by the current instrument, appears to reflect a reduction in the socio-economic level of the community in which the experiment was conducted in comparison to that from which the pilot sample was drawn. The suggestion that, as the socio-economic scale is descended, boys are encouraged to acquire masculine identification, and hence independency, at an earlier stage of development, would seem to explain the observed sex difference. This finding would seem to support a similar finding by Hartup (1958).

#### Selection of Covariates

Since the design of the experiment was essentially that of analysis of covariance, it was necessary to determine which of the covariate measures were significant contributors to the prediction of the criteria. Any reduction in the number of covariates required to





TABLE IV  
MEANS, STANDARD DEVIATIONS, AND  
t TESTS ON SEX GROUPS

Variable	Females (N=30)		Males (N=30)		t <sup>a</sup>
	Mean	S.D.	Mean	S.D.	
1. L-T Verbal IQ	116.77	12.58	111.53	14.61	1.46
2. L-T Non-verbal IQ	113.23	12.11	106.37	17.41	1.74
3. Age	129.63	5.03	134.57	7.62	2.91*
4. SES	49.07	6.90	50.33	6.67	0.71
5. STEP Science	42.80	6.37	40.93	9.48	0.88
6. Depend. Scale (1st)	40.67	5.21	35.70	6.06	3.35**
7. Depend. Scale (2nd)	40.23	6.34	36.60	6.27	2.19*
8. Sound- Time	107.17	23.97	108.33	28.53	0.17
9. Sound- Errors	9.13	9.20	7.23	7.78	0.85
10. Sound- Pretest	9.17	2.21	10.07	2.29	1.52
11. Sound- Immediate	13.17	3.89	13.07	3.74	0.10
12. Sound- Retention	13.50	4.53	14.10	4.05	0.53
13. Light- Time	124.83	30.01	122.50	38.53	0.26
14. Light- Errors	11.73	12.57	6.70	8.46	1.79
15. Light- Pretest	9.37	3.20	10.90	3.33	1.79
16. Light- Immediate	15.27	4.95	15.50	4.88	0.18
17. Light- Retention	15.80	4.61	15.57	5.77	0.17

<sup>a</sup>two tailed test, d.f.=58  
\*p<.05, \*\*p<.01



provide covariance control results in a legitimate increase in the number of degrees of freedom in the denominator, thereby lowering the value of "F" required to achieve significance.

The method of stepwise regression analysis, as described by Efroymson, (1960), provides a parsimonious, but efficient, linear prediction system. In this approach, the predictor variables are introduced into the regression equation such that at each stage, that variable is added which accounts for the largest remaining proportion of the criterion variance. The amount of variance predicted by each variable, ( $R^2$ ), and its significance to the regression equation, provide an accurate basis for selection of the relevant covariates. The correlation matrices upon which the stepwise regression analyses were computed are shown in Tables V and VI.

The results of the stepwise regression analyses are shown in Table VII. They indicate quite clearly that STEP Science, pretest scores, and verbal IQ are the most relevant predictors for both immediate and retention achievement. In addition to these three variables, it was decided that the time spent in learning and non-verbal IQ would provide adequate covariate control.

### Tests of Hypotheses

As mentioned above, tests of the four main hypotheses employed the method of applied multiple linear regression as described by Bottenberg and Ward (1963). This method permits the simultaneous inclusion



TABLE V  
CORRELATION MATRIX OF VARIABLES ENTERING  
STEPWISE REGRESSION ON SOUND CRITERIA  
(N=60)

Variable	2	3	4	5	6	7	8	9	10
1. Verbal IQ	782 <sup>a</sup>	-689	386	586	-125	-222	236	553	652
2. Non-verbal IQ		-605	354	603	-138	-216	281	577	555
3. Age			-234	-375	099	091	-060	-330	-347
4. SES				164	-249	-229	114	189	206
5. STEP Science					039	-309	433	681	662
6. Time						395	004	101	087
7. Errors							-357	-164	-236
8. Pretest								296	378
9. Immediate									766
10. Retention									

<sup>a</sup>All decimal points and diagonal elements have been omitted.



1891

1892

1893

1894

1895

1896

1897

1898

1899

1900

1901

1902

1903

TABLE VI

CORRELATION MATRIX OF VARIABLES ENTERING  
STEPWISE REGRESSION ON LIGHT CRITERIA  
(N=60)

Variable	2	3	4	5	6	7	8	9	10
1. Verbal IQ	782 <sup>a</sup>	-689	386	586	-092	-153	370	586	598
2. Non-verbal IQ		-605	354	603	-009	-161	314	528	495
3. Age			-234	-375	058	011	-154	-338	-344
4. SES				164	-192	-044	161	231	269
5. STEP Science					234	-175	486	669	747
6. Time						278	119	208	246
7. Errors							-174	-018	-140
8. Pretest								688	643
9. Immediate									799
10. Retention									

<sup>a</sup>All decimal points and diagonal elements have been omitted.



TABLE VII

STEPWISE REGRESSION ANALYSES  
(N=60)

Variable	Criteria											
	Sound Immediate			Sound Retention			Light Immediate			Light Retention		
	Step	Var.	df	t	Step	Var.	df	t	Step	Var.	df	t
1. L-T Verbal IQ	4	.006	55	0.70	2	.106	57	13.29*	3	.036	56	5.93*
2. L-T Non-verbal IQ	2	.044	57	5.05*	8	.000	51	0.00	7	.001	52	0.19
3. Age	5	.005	54	0.55	3	.016	56	1.97	6	.001	53	0.20
4. SES	6	.000	53	0.03	7	.000	52	0.01	8	.000	51	0.07
5. STEP Science	1	.463	58	-*	1	.439	58	-*	2	.147	57	22.05*
6. Time	3	.014	56	1.67	4	.015	55	1.91	5	.004	54	0.68
7. Errors	7	.000	52	0.03	6	.002	53	0.20	4	.024	55	4.13*
8. Pretest	8	.000	51	0.00	5	.009	54	1.19	1	.474	58	-*
Total Variance		.532				.586				.688		
											.718	

\* Indicates significant predictor.





of categorical and continuous data in a linear system which predicts a continuous criterion. The question asked is whether the inclusion of the predictor(s) under consideration adds significantly to the prediction system. In essence, this is the same question that the analyses of variance and covariance are required to answer. In testing the immediate hypotheses, group membership with regard to treatment (schedule of knowledge of results) will be considered as a categorical predictor. On the other hand, dependency motivation will be used as a continuous predictor, thus preserving a maximum of information.

Interaction of Dependency and Schedule of Knowledge of Results.

As an initial step, a test for interaction between dependency and schedule of knowledge of results was carried out. The full or unrestricted model was of the form:

$$Y = a_0 + a_1(X_1) + a_2(X_2) + a_3(X_3) + a_4(X_4) + a_5(X_5) + a_6(X_6) \\ + a_7(X_7) + a_8(X_8) + a_9(X_9) + a_{10}(X_{10})$$

where

$Y$  = the criterion, which varied according to the four major hypotheses

$a_0$  = the regression constant

$a_1, a_2, \dots, a_{10}$  = regression weights

$X_1$  = Lorge-Thorndike Verbal IQ

$X_2$  = Lorge-Thorndike Non-verbal IQ

$X_3$  = STEP Science

$X_4$  = Time



$X_5$  = Dependency Scale

$X_6$  = Pretest

$X_7$  = Treatment: 1 if 100% K of R, 0 otherwise

$X_8$  = Treatment: 1 if 33 1/3% K of R, 0 otherwise

$X_9$  = Interaction ( $X_5$  x  $X_7$ )

$X_{10}$  = Interaction ( $X_5$  x  $X_8$ )

To test the hypothesis of no interaction, the  $R^2$  associated with the full model is compared to the  $R^2$  of the restricted model in which  $X_9$  and  $X_{10}$  are deleted. The comparison is made by means of the F statistic:

$$F = \frac{(R_1^2 - R_2^2) / df_1}{(1 - R_1^2) / df_2}$$

where

$R_1^2$  = squared multiple correlation for the full model

$R_2^2$  = squared multiple correlation for the restricted model

$df_1$  = degrees of freedom numerator; number of unknown weights in the full model minus the number of unknown weights in the restricted model

$df_2$  = degrees of freedom denominator; number of subjects minus the number of unknown weights in the full model

The results of the tests on interaction are reported in Table VIII.

The unit on Sound provided no significant evidence of any interaction between dependency and treatment. However, the unit on Light suggested a trend toward such an interaction.



TABLE VIII

TESTS OF THE HYPOTHESIS OF NO INTERACTION  
BETWEEN DEPENDENCY AND KNOWLEDGE OF RESULTS

Criterion	$R_1^2$	$R_2^2$	df <sub>1</sub>	df <sub>2</sub>	F	Exact prob.
1. Sound Immediate	.591	.576	1	51	1.868	.178
2. Sound Retention	.625	.624	1	51	0.129	.721
3. Light Immediate	.691	.675	1	51	2.722	.105
4. Light Retention	.754	.736	1	51	3.749	.058



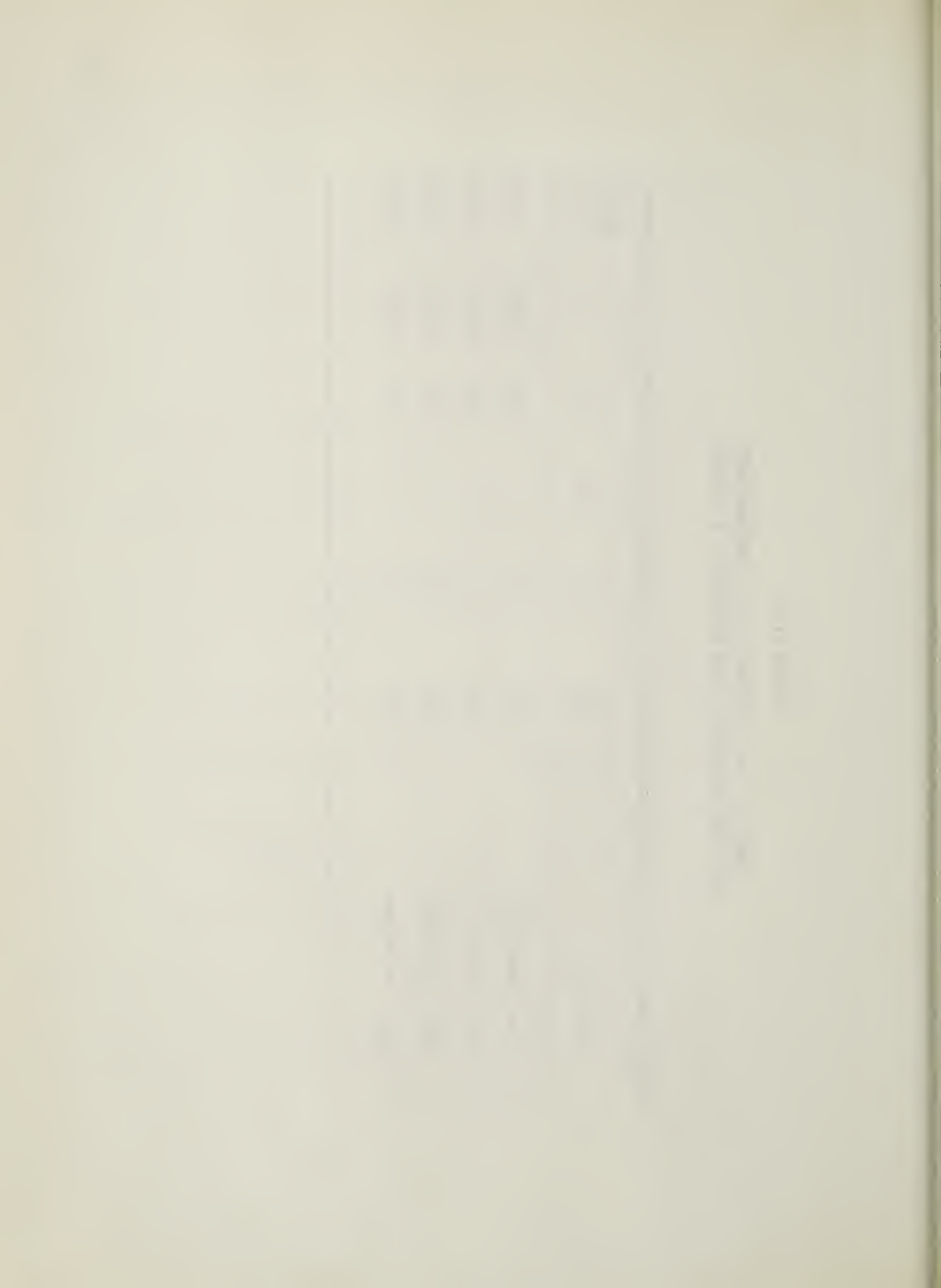


Figure 1 describes graphically the interactional relationship. It can be seen that the partial schedule of knowledge of results provides better retention on Light for low dependent subjects whereas the continuous schedule operates more effectively for high dependent subjects.

The interactional trend suggested by the immediate post-test on Light, while not at a significant level ( $p = .108$ ), is similar to that on retention.

Dependency. The choice of which of the two administrations of the dependency scale to use in testing the hypotheses on dependency resulted in the selection of the second. This decision seemed justifiable on the basis of the improved internal consistency and larger standard deviation obtained from the second testing. There was no appreciable difference between means. (See Table I)

#### Hypothesis 1

Those students who are identified as highly dependency motivated will achieve at a lower level on an immediate post-test based on a programmed instructional sequence than will those students who are identified as being less dependency motivated.

The question to be answered in testing hypotheses 1 and 2 is, whether knowledge of a student's score on the dependency scale adds significantly to the prediction of his achievement score. The results of the analyses, including the regression weights associated with the various equations are reported in Table IX.



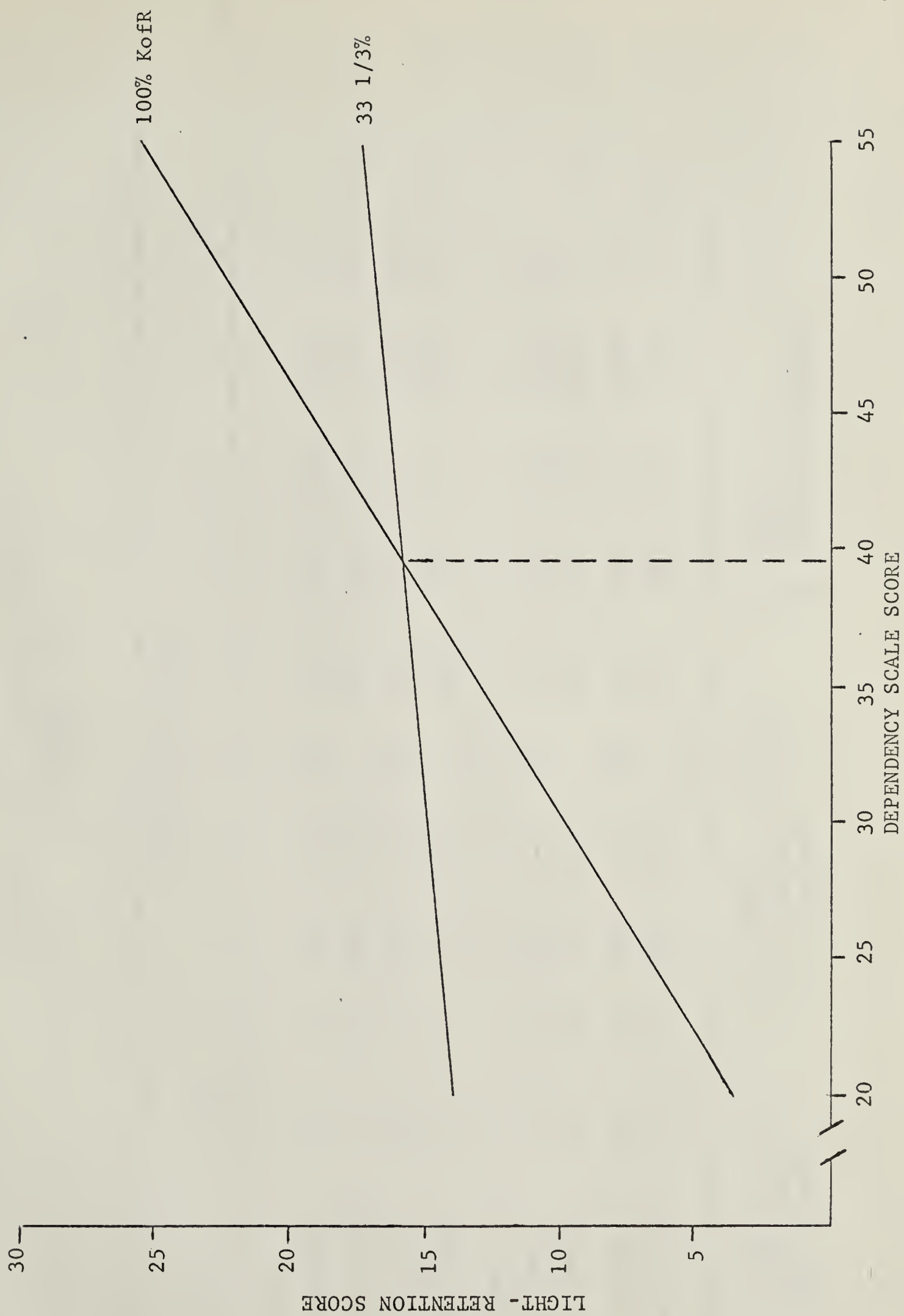


Fig. 1 Interaction between dependency and schedule of knowledge of results on Light-retention.





TABLE IX

MULTIPLE LINEAR REGRESSION TESTS OF  
HYPOTHESES 1 AND 2  
(N=60)

Hypothesis	1 <sup>a</sup>	Regression Weights								R <sup>2</sup>	df	F	prob.
		2	3	4	5	6	7	8	9				
Immediate													
1. Sound (Full)	.022	.040	.233	.015	.101	.178	1.474	.000	-11.488	.576			
Sound (Restr.)	.024	.047	.231	.015		.087	1.218	.000	-7.583	.548	1/52	3.374	.072
1. Light (Full)	.088	.008	.162	.019	.048	.639	.400	.000	-13.238	.675			
Light (Restr.)	.088	.011	.161	.017		.633	.347	.000	-11.334	.671	1/52	.633	.430
Retention													
2. Sound (Full)	.122	-.019	.204	.014	.013	.398	2.183	.000	-13.569	.624			
Sound (Restr.)	.123	-.017	.204	.014		.389	2.144	.000	-13.105	.624	1/52	.8046	.830
2. Light (Full)	.121	-.055	.305	.025	.119	.482	1.068	.000	-17.919	.736			
Light (Restr.)	.121	-.049	.301	.021		.470	.905	.000	-13.210	.715	1/52	4.145	.047

<sup>a</sup>1. L-T Verbal IQ      4. Time      7. 100% K of R  
2. L-T Non-verbal IQ      5. Dependency Scale      8. 33 1/3% K of R  
3. STEP Science      6. Pretest      9. Regression Constant



It can be seen in Table IX that Hypothesis 1 was not supported on either criterion. Rather, the immediate post-test on Sound has provided a nearly significant finding ( $p = .072$ ) which favors a contrary interpretation. That is, a student scoring high on the dependency scale would be expected to achieve higher on the immediate post-test on Sound than would a low scorer, and this, regardless of the schedule of knowledge of results.

A similar finding is not evident when the immediate post-test on Light is considered. There is no indication that knowledge of a student's dependency score is predictive of his achievement on the immediate post-test on Light.

#### Hypothesis 2

Those students who are identified as highly dependency motivated will achieve at a lower level on a retention post-test than will those students who are identified as being less dependency motivated.

Reference to Table IX indicates that this hypothesis has not been supported. No significance is attached to dependency scores in predicting the retention post-test on Sound. There is, however, a significant F-ratio associated with the Light criterion, ( $p = .047$ ), but in the opposite direction to that which was hypothesized.

Interpretation of the latter finding must be made with due consideration of a possible significant interaction between dependency and schedule of knowledge of results. (See Figure 1) While low dependents achieved better on the partial schedule and high dependents



on continuous knowledge of results, high dependents achieved significantly better than low dependents, regardless of the schedule under which they learned.

### Schedules of Knowledge of Results

#### Hypothesis 3

Students who have completed a programmed instructional sequence under a schedule of partial knowledge of results will not differ in achievement, when measured by an immediate post-test, from similar students who have learned under continuous knowledge of results.

The question which the multiple linear regression analysis attempts to answer with regard to Hypotheses 3 and 4 is, whether the schedule of knowledge of results under which a subject learns, is significantly predictive of his criterion achievement. In this analysis, treatment membership is considered to be a categorical predictor.

The results of the analyses are reported in Table X and these suggest that Hypothesis 3 has been inconsistently supported. When the criterion was the immediate post-test on Light, no difference between treatments was found. However, the comparable criterion on Sound produced an F-ratio which is significant at the .06 level, with those learning under the continuous schedule achieving the higher criterion scores.





TABLE X  
MULTIPLE LINEAR REGRESSION TESTS OF  
HYPOTHESES 3 AND 4  
(N=60)

Hypothesis	1 <sup>a</sup>	2	3	4	5	6	7	8	9	R <sup>2</sup>	df	F	prob.
Regression Weights													
Immediate													
3. Sound (Full)	.022	.040	.233	.015	.101	.178	1.474	.000	-11.488	.576			
Sound (Restr.)	.035	.047	.223	.019	.081	.060			-11.105	.546	1/52	3.698	.060
3. Light (Full)	.088	.008	.162	.019	.048	.639	.400	.000	-13.238	.675			
Light (Restr.)	.090	.009	.154	.018	.045	.661			-13.115	.673	1/52	.226	.636
Retention													
4. Sound (Full)	.122	-.019	.204	.014	.013	.398	2.183	.000	-13.569	.624			
Sound (Restr.)	.142	-.009	.189	.020	-.016	.226			-13.059	.573	1/52	7.090	.010
4. Light (Full)	.121	-.055	.305	.025	.119	.482	1.068	.000	-17.919	.736			
Light (Restr.)	.127	-.051	.282	.024	.112	.540			-17.673	.727	1/52	1.661	.203
<sup>a</sup> 1. L-T Verbal IQ 2. L-T Non-verbal IQ 3. STEP Science 4. Time 5. Dependency Scale 6. Pretest 7. 100% K of R 8. 33 1/3% K of R 9. Regression Constant													



#### Hypothesis 4

Students who have completed a programmed sequence under a schedule of partial knowledge of results will achieve at a higher level, when measured by a retention post-test, than will similar students who have learned under continuous knowledge of results.

The two tests of this hypothesis may be found in Table X. No difference was found on Light retention, however, Sound retention provided a significant F-ratio ( $p = .01$ ) which contradicts the stated hypothesis. This latter finding indicates that those who learned under the continuous schedule achieved significantly better than those under partial knowledge of results, on the retention test on Sound.

#### Teacher Influence

Associated with learning in the traditional classroom are a complex of variables directly related to the influence of the teacher as a person. The attitudes toward learning, discipline, interpersonal relations, and a myriad of others not directly related to the learning situation are certain to influence the amount and quality of learning that any student encounters during his scholastic career.

Programmed instruction, by virtue of the relative constancy that it imposes on the learning situation, should control much of the learning variance attributable to the personality of the teacher. The present study has permitted a comparison to be made on relevant variables between the two classes engaged in the experiment.





A univariate analysis of covariance, (Winer, 1962, p. 578), was used to test the hypothesis of no difference in achievement on each of the four criteria. Table XI illustrates quite clearly that both before and after imposing covariate control on the criterion measures, there was no difference in achievement of the subjects in either classroom. Thus the hypothesis is supported.

However, inspection of the covariate data indicates one minimally significant and two highly significant differences. The students of one class have scored higher on STEP Science. This can be interpreted as suggesting that one group has had a more varied introduction to the field of science than has the other.

The highly significant differences between the time taken to complete the two programs must be considered to reflect teacher attitude toward the use of time in the classroom. The writer's observation was that the characteristics of teacher-pupil relationships were somewhat more formal in the class which proceeded at the faster rate.

Since the variation in time did not influence achievement, it did, therefore, result in a greater efficiency of learning for the faster class.



TABLE XI  
ANALYSES OF COVARIANCE INVESTIGATING  
TEACHER INFLUENCE  
(N=29 & 31)

Variable	Analysis of Variance				Analysis of Covariance				prob.	F <sup>c</sup>	prob.	Analysis of Covariance				F <sup>d</sup>	prob.
	$\bar{X}_1$	$\bar{X}_2$	M.S. <sup>a</sup> <sub>T</sub>	M.S. <sup>b</sup> <sub>E</sub>	$\bar{X}_1$	$\bar{X}_2$	M.S. <sub>T</sub>	M.S. <sub>E</sub>									
Verbal IQ <sup>*</sup>	112.3	115.9	189.9	196.1	.97	.3291											
Non-verbal IQ <sup>*</sup>	108.5	111.0	97.4	243.1	.40	.5292											
STEP Science <sup>*</sup>	44.0	39.9	255.5	64.0	3.99	.0504											
Time <sup>**</sup>	120.3	96.0	8903.7	565.0	15.76	.0002											
Pretest <sup>**</sup>	9.6	9.6	.1	5.5	.01	.9225											
Immediate	13.8	12.5	25.7	14.6	1.76	.1904	13.3	13.0	.9	7.8	.12	.7337					
Retention	13.9	13.7	.2	19.2	.01	.9159	13.3	14.3	10.3	8.8	1.18	.2829					
Time <sup>**</sup>	145.7	103.1	27223.	765.9	35.55	.0000											
Pretest <sup>**</sup>	10.2	10.1	.3	11.6	.03	.8722											
Immediate	15.8	15.0	9.4	24.8	.38	.5403	15.1	15.7	2.6	9.0	.28	.5964					
Retention	16.4	15.0	32.8	27.7	1.19	.2806	15.4	15.9	2.3	9.0	.25	.6181					
<sup>a</sup> Mean Square Treatments <sup>*</sup>					<sup>b</sup> Mean Square Error <sup>**</sup>				<sup>c</sup> df=1/58				<sup>d</sup> df=1/53				
Common covariate					Specific covariate												



## CHAPTER VI

### SUMMARY AND IMPLICATIONS

It will be noted, generally, that the postulates, from which the hypotheses were derived, are not sufficient in their description of what has been found in the experimental setting described here. There is evidence to suggest, rather, that Postulates I and II, while based on a consensus of available literature, predict relationships which are contrary to those found in this study. It would, therefore, seem advisable to evaluate these postulates in the context of the present findings.

#### Postulate I

The relative inability of the student to appeal to the teacher for reassurance and support will result in a reduced learning efficiency for the dependent student. Therefore, the greater the dependency motivation of the student, the less effectively he will learn in the programmed instructional setting.

The assumption which underlies the accepted definition of dependency, and therefore the psychological construct which the present dependency scale purports to measure, is that dependent behavior is motivated by interpersonal contact, that is, dependency relationships exist only between people. The results of this study suggest that this may not be a reasonable assumption.

Two of the four tests of hypotheses derived from this postulate found significant differences in achievement favoring those subjects who were





identified as being highly dependency motivated. In the light of these findings, it seems reasonable to suggest that a redefinition of dependency motivation to include reassurances, not only from other people, but from any feedback mechanism, should be considered. The dependent individual, according to such a definition, would be described as one who learns most effectively when a high degree of communication is maintained between he and the mode of instruction, whether it be human or mechanical.

This suggestion would seem to be compatible with the findings of Amidon and Flanders (1961, p, 289), "...that dependent-prone students learned more in the classroom in which the teacher gave...more praise and asked more questions which increased their verbal participation." Praise in programmed instruction is provided through knowledge of results, a good programmer is able to anticipate the questions that the learner must answer, and covert verbal participation is a constant requisite. In essence, then, it might be argued that the programmed instructional setting is analogous to that which these writers describe and hence the parallel in the results of the two studies.

### Postulate II

Whereas immediate post-test achievement would not be expected to differ significantly, students who have learned under the condition of partial knowledge of results should retain significantly more of the programmed content as measured by a retention achievement test, than those students who have learned with continuous knowledge of results.



Only one of the four tests of hypotheses derived from this postulate was supported by the experimental evidence. The immediate post-test on Light showed no difference between treatments (knowledge of results), and thus supported the hypothesis of no difference on immediate testing. However, the immediate post-test on Sound, which was the program first presented, resulted in a difference between treatments ( $p = .060$ ) favoring the 100% schedule.

A reasonable interpretation of this inconsistency would suggest that the subjects who learned under the partial schedule had some difficulty at first, but were able to develop an adequate means of utilizing the internal cueing as they gained experience with the new method of learning. It would seem, then, that immediate post-test achievement should not be expected to differ according to the schedule of knowledge of results, provided of course, that there are sufficient cues in the text.

When we turn to the effects of schedules of knowledge of results on retention, the experiment has provided no support for the suggestion of Brackbill and Kappy (1962), and Festinger (1961), that a partial schedule will facilitate retention. The retention test on Sound provided a very significant difference ( $p = .010$ ) with those learning under the continuous schedule achieving a higher level. The fact that a similar difference was not found on the Light retention test seems to confirm the suggestion of an improving ability to utilize internal cues as the novice to programmed instruction becomes more familiar with the





learning procedure. There is reason to suspect that achievement on subsequent programs might not differ with regard to the schedule of knowledge of results.

#### Interaction of Dependency and Schedule of Knowledge of Results

Interaction was tested under the null hypothesis. On three of the four tests, the null hypothesis was accepted. The retention test on Light, however, provided an interaction that was significant at the  $p = .058$  level. (See Fig. 1) Two additional measures, Sound immediate and Light immediate, supported this interactional trend.

These findings are not sufficiently stable to establish a definite relationship. However, they are suggestive of an interesting phenomenon which, if validated, could provide some basis for the differential application of programs. The interaction indicates that a highly dependent student will achieve at a higher level under continuous knowledge of results, whereas, a low dependent student will achieve better under a partial schedule. Since, ideally, the learning situation should be suited to the learner, a finding of this nature would be of some importance for the optimal utilization of programs.

#### Influence of the Teacher

The present study investigated, quite briefly, the influence, that a teacher might have on learning by programmed instruction. The results



indicate that the only variable over which the teacher may have some control is the time required to complete a program. The teacher's attitude toward classroom discipline appears to be the relevant factor here. One class completed both programs in significantly less time than the other with no difference in achievement. The teacher of the faster class, maintained a somewhat more formal relationship with the students than did the other, and tolerated less inter-student contact throughout the experiment. It would seem, then, that students learning by programmed instruction can be paced by the teacher to provide a higher learning efficiency.

#### Limitations of the Study

Every effort was made to provide for a study that was both experimentally sound and generalizable to a fairly large school population. However, as with most, if not all, such investigations, there are obvious shortcomings.

The sample cannot be considered generally representative of the school population. The socio-economic character of the district which the school serves is somewhat more homogeneous than would normally be found in the population at large. Consequently, a more effective sample would have been obtained from two or three schools serving diverse districts. This was the original intention of the writer but not possible to achieve.



The reliability of the measurement instruments, particularly the pretest on Sound, should ideally have been better. (See Appendix C) This lack of precision, of course, increases error variance with the resulting loss of power in tests of significance.

There is reason to suspect confounding with regard to the attempt to derive construct validity of the Dependency Scale. The fact that students were told that they might ask questions of either the teacher or the writer, may well have contributed to the establishment of uncontrolled dependency relationships with the adults. Undoubtedly, it would have been better to have referred the student to the instructions in the program or otherwise maintained a somewhat aloof relationship. In this manner, it could be more certainly assumed that an "act of dependency" was a reflection of the student's past experience, and not a manifestation of the immediate setting.

One further point refers to the accuracy of the error count. The rather extreme differences in errors reported, with well over half of the subjects reporting fewer than ten errors for each program, (See Appendix E), causes one to suspect that all subjects had not freely disclosed their errors. The only way that an accurate error count may be made is to use overt responding in a program presented by a fairly complex machine. However, it may well be, as is suggested in this study, that the number of errors reported is not a significant variable in programmed learning.





### Implications for Further Research

As mentioned in the introduction to Chapter III, this study is essentially an empirical investigation. It has attempted to relate one personality variable, dependency motivation, and two schedules of knowledge of results, to programmed instruction. Inspection of the literature indicates that neither of these have been adequately studied in the programmed setting.

The results of the study suggest that the theoretical concept of dependency, bound as it is to interpersonal relations, may require a broader interpretation. Future research should be directed toward a closer look at this and other personality correlates of learning, not only by programmed instruction, but in the classroom setting as well.

The influence of scheduling knowledge of results has received only a cursory investigation by researchers in the field. If the animal studies of partial and delayed reinforcement are to have meaning for human learning, the programmed setting would seem to provide the closest approximation to that in which the animal studies are conducted. In this way, not only schedules may be varied, but also the amount of cueing and redundancy that is provided for the learner.

It has been found here, that students learning under a partial schedule were at first unable to derive adequate feedback for achievement comparable to those learning under a continuous schedule. However, as their experience increased, those learning under the partial schedule



appeared to have developed an adequate means of utilizing internal cues. It would be of real interest to determine whether this trend would ultimately result in the increased retention predicted, if the same students, over an extended period, were presented with programs that were gradually reduced in redundancy and cueing. In this way, the added effort required, coupled with a developed skill in utilizing cues, might provide for the suggested improvement in retention when partial and continuous schedules are compared.

In addition, the inverted "U" relationship between schedule of reinforcement and retention that has been found to exist in animal studies may also hold for programmed instruction. It is conceivable that some combination of amount of cueing and schedule of knowledge of results would provide for an optimal level of retention.

The study has attempted to provide cross-validated evidence for its findings. This is a desirable requirement of all research not, however, always possible within a single study. Even when such evidence is provided, it falls to other investigators to substantiate, or negate, the findings as can only be done with fresh ideas and differing perspectives.

#### Implications for Educational Practice

The ability of programmed instruction to provide for an efficient learning situation over a wide age range and across many content areas is





an established fact. Evidence is provided here that scientific concepts of a rather advanced nature can be learned by fifth grade students through the medium of an inexpensive programmed text.

There is a suggestion that those students who are highly dependency motivated may learn optimally under continuous knowledge of results due to the constant communication that is maintained between the learner and his source of information. Teachers should be aware of this need in dependent students and attempt to provide learning experiences that involve a maximum of feedback.

Today, 10 years after its formal introduction by Skinner and his associates, programmed instruction is still not part of the professional repertoire of most teachers. Educators should be encouraged by the fact that many of the fundamentals in most subject areas can be presented at least as efficiently, if not more so, by programmed instruction. The teacher who has a library of well developed programs available can provide much richer learning experiences for his students. The basic information can be presented by a program and he is then permitted the time to better prepare his presentation of generalizations and applications.

The age of automation is very much with us and the education system must be prepared to meet its challenge of an accelerating technology. The application of programmed instruction to much of the didactic material that teachers must present might well be, in considerable measure, an answer to that challenge.



## B I B L I O G R A P H Y



- Amidon, E., & Flanders, N. A. The effects of direct and indirect teacher influence on dependent-prone students learning geometry. J. educ. Psychol., 1961, 52, 286-291.
- Amsel, A. Error responses and reinforcement schedules in self-instructional devices. In A. A. Lumsdaine & R. Glaser (Eds.), Teaching machines and programmed learning: A source book. Washington, D. C.: Nat. Educ. Assoc., 1960. Pp. 506-516.
- Bandura, A., & Walters, R. H. Social learning and personality development. Toronto: Holt, Rhinehart and Winston, 1963.
- Bellak, L. A guide to the interpretation of the Thematic Apperception Test. New York: Psychological Corporation, 1951.
- Beller, E. K. Dependency and independency in young children. J. genet. Psychol., 1955, 87, 25-35.
- Bernardin, A. C., & Jessor, R. A construct validation of the Edwards Personal Preference Schedule with respect to dependency. J. consult. Psychol., 1957, 21, 63-67.
- Bloom, B. S. (Ed.), Taxonomy of educational objectives. Handbook I: Cognitive domain. New York: D. McKay, 1956.
- Bottenberg, R. A., & Ward, J. H. Applied multiple linear regression. Alexandria, Virginia: Defense Documentation Center, Publication No. AD413218, 1963.
- Bourne, L. E. Effects of delay of information feedback and task complexity on the identification of concepts. J. exp. Psychol., 1957, 54, 201-207.
- Brackbill, Yvonne, & Kappy, M. S. Delay of reinforcement and retention. J. comp. physiol. Psychol., 1962, 55, 14-18.
- Cairns, R. B. Influence of dependency inhibition on the effectiveness of social reinforcement. J. Pers., 1961, 29, 466-488.
- Cairns, R. B., & Lewis, M. Dependency and the reinforcement value of a verbal stimulus. J. consult. Psychol., 1962, 26, 1-8.
- Chansky, N. M. Learning: a function of schedule and type of feedback. Psychol. Rep., 1960, 7, 362.





- Chansky, N. M. Reactions to systems of guiding learning. Amer. educ. res. J., 1964, 1, 95-100.
- Crandall, V. J., Preston, A., & Rabson, A. Maternal reactions and the development of independence and achievement behavior in young children: Child Developm., 1960, 31, 243-251.
- Crowder, N. A. Automatic tutoring by intrinsic programming. In A. A. Lumsdaine and R. Glaser (Eds.), Teaching machines and programmed learning: A source book. Washington: National Education Association, 1960, Pp. 286-298.
- Daniels, L. A. (Ed.) Bulletin 2B: Science. Edmonton: Queen's Printer, 1963.
- Elley, W. B. A comparative analysis of the socio-economic bias in selected intelligence tests. Unpublished doctoral dissertation. Univer. of Alberta, 1961.
- Edwards, A. L. Edwards personal preference schedule. New York: Psychological Corp., 1959.
- Efroymsen, M. A. Multiple regression analysis. In A. Ralston & H. S. Wilf (Eds.), Mathematical methods for digital computers. New York: John Wiley & Sons, 1960, Pp. 191-203.
- Endsley, R. C., & Hartup, W. W. Dependency and performance by preschool children on a socially reinforced task. Amer. Psychologist, 1960, 15, 399. (Abstract)
- Evans, J. L., Glaser, R., & Homme, L. E. The development and use of a "standard" program for investigating programmed verbal learning. Amer. Psychologist, 1960, 15, 424. (Abstract)
- Ferguson, G. A. Statistical analysis in psychology and education. Toronto: McGraw-Hill, 1959.
- Festinger, L. The psychological effects of insufficient rewards. Amer. Psychologist, 1961, 16, 1-11.
- Fiks, A. I. Some treatment and population variables in programmed instruction. J. educ. Psychol., 1964, 55, 152-158.
- Flanders, N. A., Anderson, J. P., & Amidon, E. J. Measuring dependence-proneness in the classroom. Educ. psychol. Measmt., 1961, 21, 575-587.



- Goldbeck, R. A., & Campbell, V. N. The effects of response mode and response difficulty on programmed learning. J. educ. Psychol., 1962, 53, 110-118.
- Gough, H. G. Manual for the California Psychological Inventory. Palo Alto: Consulting Psychologists Press, 1957.
- Hartup, W. W. Nurturance and nurturance-withdrawal in relation to the dependency behavior of young children. Child Developm., 1958, 29, 191-201.
- Hartup, W. W. Dependence and independence. In H. W. Stevenson (Ed.), Yearb. nat. Soc. Stud. Educ., 1963, 62, Part I, Pp. 333-363.
- Heathers, G. Emotional dependence and independence in nursery school play. J. genet. Psychol., 1955(a), 87, 37-57.
- Heathers, G. Acquiring dependence and independence: a theoretical orientation. J. genet. Psychol., 1955(b), 87, 277-291.
- Holland, J. L. The prediction of college grades from the California Psychological Inventory and the Scholastic Aptitude Test. J. educ. Psychol., 1959, 50, 135-142.
- Jakubczak, F., & Walters, R. H. Suggestibility as dependency behavior. J. abnorm. soc. Psychol., 1959, 59, 102-107.
- Jenkins, W. O., & Stanley, J. C. Partial reinforcement: a review and critique. Psychol. Bull., 1950, 47, 193-234.
- Kagan, J., & Moss, H. A. The stability of passive and dependent behavior from childhood through adulthood. Child Developm., 1960, 31, 577-591.
- Kagan J., & Mussen, P. Dependency themes on the T.A.T. and group conformity. J. consult. Psychol., 1956, 20, 29-32.
- Keislar, E. R., & McNeil, J. D. A comparison of two response modes in an autoinstructional program with children in the primary grades. J. educ. Psychol., 1962, 53, 127-131.
- Krumboltz, J. D. Meaningful learning and retention: Practice and reinforcement variables. Rev. educ. Res., 1961, 31, 535-546.
- Krumboltz, J. D., & Weisman, R. G. The effect of overt versus covert responding to programmed instruction on immediate and delayed retention. J. educ. Psychol., 1962(a), 53, 89-92.





- Krumboltz, J. D., & Weisman, R. G. The effect of intermittent confirmation in programed instruction. J. educ. Psychol., 1962(b), 53, 250-253.
- Lewis, D. J. Partial reinforcement: A selective review of the literature since 1950. Psychol. Bull., 1960, 57, 1-28.
- Livson, N., & Mussen P. The relation of control to overt aggression and dependency. J. abnorm. soc. Psychol., 1957, 55, 66-71.
- Lorge, I., & Thorndike, R. L. The Lorge-Thorndike intelligence tests. Cambridge, Mass.: The Riverside Press, 1954.
- Lumsdaine, A. A. Instruments and media of instruction. In N. L. Gage (Ed.), Handbook of research on teaching. Chicago: Rand McNally, 1963, Pp. 583-683.
- McCandless, B. R., Bilous, Carolyn, B., & Bennett, Hannah, L. The relation between peer-popularity and dependence on adults in preschool-age socialization. Child Developm., 1961, 32, 511-518.
- McCandless, B. R., & Marshall, Helen, R. Sex differences in social acceptance and participation of preschool children. Child Developm., 1957, 28, 421-425.
- McClelland, D. C., Atkinson, J. W., Clark, R. A., & Lowell, E. L. The achievement motive. New York: Appleton-Century-Crofts, 1953.
- McCord, W., McCord, Joan, & Verden, P. Familial and behavioral correlates of dependency in male children. Child Developm., 1962, 33, 313-326.
- Marshall, H. R., & McCandless, B. R. Relationship between dependence on adults and social acceptance by peers. Child Developm., 1957, 28, 413-419.
- Middleton, G., & Guthrie, G. M. Personality syndromes and academic achievement. J. educ. Psychol., 1959, 50, 66-69.
- Morgan, H. H. A psychometric comparison of achieving and non-achieving college students of high ability. J. consult. Psychol., 1952, 16, 292-298.
- Murray, H. A. Explorations in personality. New York: Oxford Univer. Press, 1938.



- Murray, H. A. Thematic Apperception Test. Cambridge, Mass.: Harvard Univer. Press, 1943.
- Neville, F. J. A test of preferences. Unpublished term assignment, Carleton College, 1955.
- Renner, K. E. Delay of reinforcement: a historical review. Psychol. Bull., 1964, 61, 341-361.
- Saltzman, I. J. Delay of reward and human verbal learning. J. exp. Psychol., 1951, 41, 437-439.
- Sears, R. R. Dependency motivation. In M. R. Jones (Ed.), Nebraska symposium on motivation. Lincoln: Univer. of Nebraska Press, 1963, Pp. 25-64.
- Sears, R. R., Maccoby, Eleanor, E., & Levin, H. Patterns of child training. Evanston: Row Peterson, 1957.
- Sears, R. R., Whiting, J. W. M., Nowlis, V., & Sears, Pauline, S. Some child rearing antecedents of aggression and dependency in young children. Genet. psychol. Monogr., 1953, 47, 135-234.
- Educational Testing Service. Sequential tests of educational progress. Princeton: Author, 1957.
- Siegel, A. E., Stolz, L. M., Hithcock, E. A., & Adamson, J. Dependence and independence in the children of working mothers. Child Develpm., 1959, 30, 533-546.
- Skinner, B. F. Teaching machines. Scientific American, Nov. 1961.
- Skinner, B. F. Operant behavior. Amer. Psychologist, 1963, 18, 503-515.
- Stendler, Celia, B. Possible causes of overdependency in young children. Child Develpm., 1954, 25, 124-146.
- Stith, Marjorie, & Connor, Ruth. Dependency and helpfulness in young children. Child Develpm., 1962, 33, 15-20.
- Stolurrow, L. M., & Walker, C. C. A comparison of overt and covert response in programmed learning. J. educ. Res., 1962, 55, 421-429.
- Taylor, R. G. Personality traits and discrepant achievement: a review. J. counsel. Psychol., 1964, 11, 76-82



- Unruh, W. R. An investigation of four methods of presenting programmed material. Unpublished master's thesis. Univer. of Alberta, 1962.
- Winer, B. J. Statistical principles in experimental design. Toronto: McGraw-Hill, 1962.
- Winterbottom, Marian, R. The relation of need for achievement to learning experiences in independence and mastery. In J. W. Atkinson (Ed.), Motives in fantasy, action, and society. Toronto: Van Nostrand, 1958, Pp. 453-478.
- Wittrock, M. C. Response mode in the programing of kinetic molecular theory concepts. J. educ. Psychol., 1963, 54, 89-93.
- Zuckerman, M., and Grosz, H. J. Suggestibility and dependency. J. consult. Psychol., 1958, 22, 328.





## APPENDIX A.

### EXAMPLE OF THE SCIENCE TUTOR



the \_\_\_\_\_ waves from the flashlight. The broken lines show the \_\_\_\_\_ light.

248. light, reflected 249. The reflected light shines on the \_\_\_\_\_.

249. wall 250. Have you noticed how bright it is when snow is on the ground? The sunlight hits the snow. The snow \_\_\_\_\_ the light.

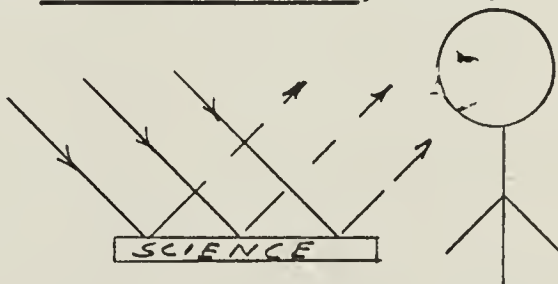
250. reflects 251. We know a mirror reflects \_\_\_\_\_. A mirror is very smooth. Because the smooth mirror reflects light, we can see our faces in a mirror.

251. light 252. We call the picture of ourselves in the mirror an image. You could see an i \_\_\_\_\_ of a book, if you put a book in front of a mirror.

252. image 253. Many things reflect light, but you must look into a very, very smooth object, like a mirror, before you can see an \_\_\_\_\_.

253. image 254. Light from the sun or a flashlight hits many objects. Many times the light is bounced back or r \_\_\_\_\_. When sunlight hits snow, the light is reflected.

254. reflected 255. When light from an object reaches your eyes, you can see it. Light from the sun or a light bulb hits your science book. The \_\_\_\_\_ is bounced back or reflected. The light from your science book reaches your \_\_\_\_\_, and you can see the book.



255. light, eyes 256. You cannot see around corners. If you could, your friends would not be able to hide from you. Light travels in straight lines unless it is reflected or bent by some material. Light travels in \_\_\_\_\_ lines.

256. straight 257. Light will not curve around a corner or bend by itself, therefore, we say light travels in a \_\_\_\_\_ line..





## APPENDIX B.

### THE DEPENDENCY SCALE



# AGREE OR DISAGREE

Here are some statements about which you will have an opinion. If you AGREE with what the statement says, mark an X through the "A" that is beside the proper number on the answer sheet. If you DISAGREE with the statement, mark an X through the "D" on the answer sheet. Use a black pencil and erase carefully if you change your mind.

Please PRINT your name and your teacher's name on the answer sheet now.

Here is an example:

a. I like to play baseball.

Although there is no time limit, do not spend too much time on any one statement. Do not miss any statements.  
Read carefully.

- |     |   |     |  |
|-----|---|-----|--|
| KEY |   | KEY |  |
| D   | 1. I like to make my own decisions  | D   | 11. I often disagree with what the class decides to do.                |
| D   | 2. I sometimes break rules if it makes my friends like me.                  | D   | 12. My parents make unreasonable rules.                                |
| A   | 3. I never argue with my parents.   | D   | 13. I dislike lending things to my friends.                            |
| D   | 4. My folks usually have to ask me twice to do something.                   | D   | 14. I often seem to do things my parents don't like.                   |
| A   | 5. I never do anything at home until I find out if it's okay.               | D   | 15. I like people who ignore the feelings of others.                   |
| D   | 6. I don't like to show my friends how much I like them.                    | D   | 16. My parents treat me like a little child.                           |
| D   | 7. I often disagree with my parents.  | D   | 17. I enjoy studying about things that my parents don't like.          |
| D   | 8. I seldom do "little extra things" at home just to please my parents.     | D   | 18. I often disagree with what the teacher says.                       |
| D   | 9. It annoys me when my friends tell me their troubles                      | D   | 19. I don't care if others are not interested in the same things I am. |
| A   | 10. You should always check to see if your parents approve of your friends. | A   | 20. I try never to disobey my parents.                                 |

# RECORD OF DEEDS

THIS RECORD OF DEEDS contains a list of all the deeds recorded in the office of the Register of Deeds for the County of [County Name], State of [State Name], from the year 1800 to the year 1899. The deeds are arranged in alphabetical order of the names of the parties to the same.

For a full and complete list of the deeds recorded in this office, see the

Index to this Record.

## INDEX TO THIS RECORD

For a full and complete list of the deeds recorded in this office, see the

Index to this Record. The Index is arranged in alphabetical order of the names of the parties to the deeds.

Name of Party	Date	Description of Deed	Page
[Name]	[Date]	[Description]	[Page]
[Name]	[Date]	[Description]	[Page]
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## MY PREFERENCES

Here are some questions about your preferences in some of the little and some of the big things in life. The only correct answer is the one which you feel best describes your preferences. This means that the correct answer for one person may not be correct for another.

Here is an example to show you how it is done.

b. If I became lost in the city, I would

- A ask directions of a policeman
- B try to find my way home by myself
- C wait until someone offers to help me
- D telephone my parents and ask them to come and get me

For some, the answer will be A, while for others it will be B or C or D. The only right answer is the one that best describes your own personal preference.

Be careful to mark the letter you choose on the answer sheet.

21. If a circus were coming to town and I was allowed to go and watch the parade, I would prefer to

KEY

- 3 A watch it with my parents
- 1 B watch it with several of my friends, but not with my parents
- 4 C stay at home if my parents could not go with me
- 2 D watch it with one special friend

22. If my class was putting on a play, I would prefer to

- 2 A take the leading part
- 1 B take a small part
- 3 C work behind the stage with a special friend
- 4 -D help the teacher to direct it

23. If I were going out to a cafe for supper, I would prefer to

- 4 A ask my parents to help me choose what I eat
- 3 B choose the same food as my parents
- 2 C choose food I have often had at home before
- 1 D choose something I have not had before or have not had very often

24. If I was given the choice of belonging to a club, I would

- 2 A choose the club where I think I will find adventure
- 3 B choose the club to which my closest friend belongs
- 1 C choose the club where I will meet new friends
- 4 D choose the club which my parents tell me is the best





25. If I was going to join a club or a group of young people, I would prefer to

KEY

- 4 A have the teacher be the leader
- 2 B have one of my friends be the leader
- 3 C be the leader myself
- 1 D have a grown-up person, other than the teacher be the leader

26. I would like this club to have

- 3 A no rules at all
- 4 B a lot of rules
- 1 C only a few strict rules
- 2 D only a few easy rules

27. If the club did have rules, I would prefer to

- 4 A have the teacher make the rules
- 2 B have my friends make the rules
- 3 C make the rules myself
- 1 D help my friends to make the rules

28. When I get up in the morning I like to

- 2 A choose my own clothes for that day but have my parents help me dress
- 1 B choose my own clothes and dress myself
- 3 C have my parents choose my clothes for the day and help me get dressed
- 4 D have my parents choose my clothes but dress myself

29. If my parents were going to be away from home for an evening, I would prefer to

- 3 A have an adult come in and stay with me
- 4 B go and stay with my grandparents
- 1 C stay at home alone
- 2 D go to the home of a friend

30. If I were going on a picnic I would prefer to

- 2 A have a special friend go along with me
- 3 B have my teacher go along with me
- 4 C have my parents go along with me
- 1 D have several of my friends go along with me



APPENDIX C.

ACHIEVEMENT TEST DATA





DESCRIPTIVE STATISTICS OF  
THE ACHIEVEMENT TESTS  
(N=60)

Test	No. Items	Mean	Range	S.D.	KR-20 Reliability
1. Sound Pretest	25	9.62	3-13	2.30	.233
2. Sound Immediate	25	13.12	4-19	3.82	.642
3. Sound Retention	26	13.80	4-22	4.31	.689
4. Light Pretest	30	10.13	3-18	3.35	.543
5. Light Immediate	30	15.38	5-25	4.92	.744
6. Light Retention	32	15.68	4-25	5.23	.755



APPENDIX D.

THE CRITERION TESTS  
(RETENTION)



A TEST IN ELEMENTARY SCIENCESOUND

For each of the questions below select the best possible answer.

1. Scientists have shown that sound travels
  - A. slower than light
  - B. much slower than light
  - C. about the same speed as light
  - D. faster than light
2. Sound travels fastest when passing through
  - A. a solid
  - B. a liquid
  - C. a vacuum
  - D. a gas
3. Sound travels in the form of
  - A. molecules
  - B. electrons
  - C. waves
  - D. rays
4. Why are the walls of music rooms and radio studios often given special shapes or are covered with special materials?
  - A. to make the sounds louder
  - B. to avoid disturbing the neighbors
  - C. to produce interesting echoes
  - D. to control sound reflection
5. Which of the following both tend to increase the pitch of a vibrating string?
  - A. an increase in length and a decrease in the tightness of the string
  - B. an increase in the thickness, and a decrease in the length of the string
  - C. a decrease in the thickness, and an increase in the tightness of the string
  - D. a decrease in the tightness and a decrease in the thickness of the string
6. How are echoes produced?
  - A. by reflection of sound waves from distant objects
  - B. by sound waves which are driven back by the wind
  - C. by sound waves being absorbed by hard surfaces
  - D. by vibrations in distance objects





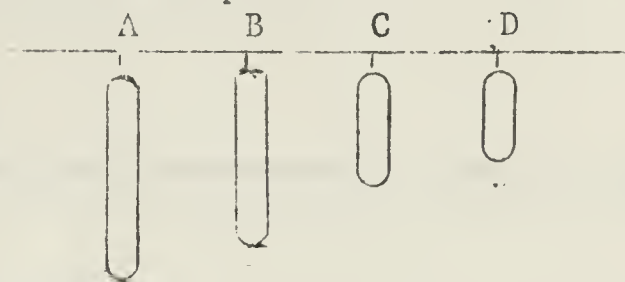
- 2 -

7. Sound will not travel in a
- A. tank of water
  - B. metal pipe
  - C. glass jar
  - D. vacuum tank
8. When a tree falls in a forest, there will be a sound only if
- A. the tree hits the ground with a thud
  - B. some animal is there to hear the thud
  - C. the branches on the tree broke as it hit the ground
  - D. sound waves were created when the tree struck the ground
9. The fact that a man has a low-pitched voice tell us that his vocal cords
- A. are short and thin
  - B. are tightly stretched
  - C. do not vibrate rapidly
  - D. vibrate rapidly
10. If a friend of yours was to ring a bell about one hundred *yards* from you, where would you hear the sound most clearly?
- A. if you were on the moon
  - B. if you were down a coal mine
  - C. if you were in the middle of a large field
  - D. if both the bell and your head were under water
11. The pitch produced by different keys on a piano is different mainly because of the differences in the
- A. length of time that the stringsvibrate
  - B. the speed of vibration of the strings
  - C. material against which the sound waves are reflected
  - D. speed with which the hammers hit the strings
12. The ripples caused by a stone dropped into water and the sound from a ringing bell are similar because
- A. they both make a noise
  - B. they can both be seen
  - C. they are both wave motion
  - D. they are both reflections
13. Sound will not travel through
- A. a solid
  - B. a liquid
  - C. a gas
  - D. a vacuum



- 3 -

14. Some boys made a set of chimes by hanging four pieces of pipe of different lengths from a bar as shown in the picture below. Which of the four pipes made the lowest pitched sound when struck with a hammer?



- A. pipe A  
B. pipe B  
C. pipe C  
D. pipe D
15. Sound travels through air at a speed of  
A. 1100 yards per second  
B. 1100 feet per second  
C. 1100 miles per minute  
D. 1100 feet per minute
16. Sounds occur when  
A. a bell is rung  
B. two cars have an accident  
C. lightning strikes the ground  
D. an eardrum vibrates
17. If I wanted a sound to be heard a mile away, the fastest way of getting the sound there would be by  
A. striking a railroad track a mile long  
B. striking an iron bar in the air  
C. ringing a bell  
D. striking an iron bar in the water of a lake
18. Suppose you have four very tight strings. They are all thin. The string that would have the highest pitch would be  
A. the string 25 inches long  
B. the string 20 inches long  
C. the string 15 inches long  
D. the string 10 inches long
19. Which one of the following surfaces would produce the best echo?  
A. soft, smooth  
B. hard, rough  
C. soft, rough  
D. hard, smooth
20. If I hear the sound of a jet plane very high up and want to see where it is, I should  
A. look behind where the sound seems to coming from  
B. look ahead of where the sound seems to be coming from  
C. look directly at where the sound seems to be coming from  
D. look above where the sound seems to be coming from





- 4 -

21. The speed of sound is fastest in
- A. air
  - B. iron
  - C. wood
  - D. water
22. Which one of the following musical instruments is able to make the lowest pitched sound?
- A. piano
  - B. saxophone
  - C. trumpet
  - D. pipe organ
23. Which one of the following is not a form of vibration
- A. the siren on a police car
  - B. the flashing red light on the police car
  - C. the squeal of brakes when they stop the police car
  - D. the roar of the car's motor
24. Sound is possible only if some object is
- A. heated
  - B. vibrated
  - C. stretched
  - D. compressed
25. Sound travels slowest when passing through
- A. a solid
  - B. a liquid
  - C. a vacuum
  - D. a gas
26. Suppose you saw your friend chopping wood. You could see the axe hit the wood and then you could hear the sound later. If it took  $2\frac{1}{2}$  seconds for the sound to reach you about how far away is your friend?
- A.  $\frac{1}{2}$  mile
  - B. 1 mile
  - C.  $1\frac{1}{2}$  miles
  - D.  $2\frac{1}{2}$  miles



A TEST IN ELEMENTARY SCIENCELIGHT

For each of the questions below select the best possible answer.

1. The filaments of a modern light bulb are made of a material called
  - A. carbon
  - B. steel
  - C. copper
  - D. tungsten
2. Most electric light bulbs are filled with a gas called
  - A. oxygen
  - B. argon
  - C. phosphorous
  - D. neon
3. A fluorescent light gives off light because
  - A. the filament glows
  - B. the electricity is refracted
  - C. gas particles bump into the sides of the tube
  - D. the carbon coil gets very hot
4. What effect does the wearing of properly fitted glasses have on the eyes of those who have poor vision?
  - A. glasses tend to weaken the eyes.
  - B. glasses tend to improve vision and reduce strain on the eyes.
  - C. glasses tend to remedy disease of the eyes and improve the strength of the eyes gradually.
  - D. glasses correct certain faults in vision, but are likely to speed up the development of others.
5. Light travels in
  - A. curved lines
  - B. irregular paths
  - C. straight lines
  - D. circles
6. When sunlight strikes clean white snow, most of the light will be
  - A. absorbed
  - B. radiated
  - C. refracted
  - D. reflected

Category	Value
1. Total	100
2. ...	...
3. ...	...
4. ...	...
5. ...	...
6. ...	...
7. ...	...
8. ...	...
9. ...	...
10. ...	...

- 2 -

7. The bending of light waves is called
  - A. refraction
  - B. reflection
  - C. rarefaction
  - D. inversion
8. Most of the light we use today for lighting our homes is
  - A. natural light
  - B. fluorescent light
  - C. artificial light
  - D. carbon light
9. What is it that partly explains how light gets into a room whose windows are on the shady side of the house?
  - A. the light curves and enters the room
  - B. the light is reflected from the inside walls of the room
  - C. the light is reflected in by objects outside the room
  - D. the window acts like a camera lens and brings the light in
10. Light travels from the sun to the earth in about
  - A. one year
  - B. two hours
  - C. five seconds
  - D. eight minutes
11. Why are walls usually given a rough finish rather than a smooth one?
  - A. wall paper sticks better to a rough wall.
  - B. a rough wall absorbs less light.
  - C. a rough wall spreads the light it reflects.
  - D. a rough surface is a good reflector of light.
12. White light can be broken into rainbow colors by means of a
  - A. mirror
  - B. prism
  - C. light meter
  - D. reflector
13. Which one of the following shines by reflected light?
  - A. a star
  - B. the moon
  - C. the sun
  - D. a falling star
14. Which one of the following cannot be used to refract light?
  - A. a convex lens
  - B. a concave lens
  - C. a prism
  - D. a mirror



12. The following are the names of the four main branches of the tree of life. Which one is not a branch of the tree of life?

A. Bacteria  
B. Eukarya  
C. Archaea  
D. Protista

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A. Bacteria  
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C. Archaea  
D. Protista

- 3 -

15. A bright blue coat contains a dye which absorbs all the following colors except
- A. red
  - B. orange
  - C. green
  - D. blue
16. When a ray of sunlight goes through glass and changes its direction, the color of the ray which bends most is?
- A. blue
  - B. violet
  - C. orange
  - D. red
17. We are able to see a red sweater because
- A. the red light rays are absorbed by the sweater
  - B. all other colors except red are reflected by the sweater
  - C. the red light rays are not absorbed by the sweater
  - D. all colors are reflected by the sweater
18. The largest source of light known to mankind is
- A. the sun
  - B. the stars
  - C. an atomic explosion
  - D. the moon
19. The first models of the electric light bulb were unsuccessful mainly because
- A. the filaments would not work properly because of air in the bulb
  - B. the glass bulbs broke too easily when the air was removed
  - C. there was not a large enough supply of electricity available
  - D. the proper material for the filament could not be found
20. Which of the following does not have a convex lens?
- A. the human eye
  - B. a magnifying glass
  - C. a searchlight
  - D. a telescope
21. Which one of the following does not refract light?
- A. water
  - B. a lens
  - C. a mirror
  - D. a prism

1. The first of the following is a true statement. Which one is it?

- A. The first of the following is a true statement.
- B. The second of the following is a true statement.
- C. The third of the following is a true statement.
- D. The fourth of the following is a true statement.

2. The second of the following is a true statement. Which one is it?

- A. The first of the following is a true statement.
- B. The second of the following is a true statement.
- C. The third of the following is a true statement.
- D. The fourth of the following is a true statement.

3. The third of the following is a true statement. Which one is it?

- A. The first of the following is a true statement.
- B. The second of the following is a true statement.
- C. The third of the following is a true statement.
- D. The fourth of the following is a true statement.

4. The fourth of the following is a true statement. Which one is it?

- A. The first of the following is a true statement.
- B. The second of the following is a true statement.
- C. The third of the following is a true statement.
- D. The fourth of the following is a true statement.

5. The fifth of the following is a true statement. Which one is it?

- A. The first of the following is a true statement.
- B. The second of the following is a true statement.
- C. The third of the following is a true statement.
- D. The fourth of the following is a true statement.

6. The sixth of the following is a true statement. Which one is it?

- A. The first of the following is a true statement.
- B. The second of the following is a true statement.
- C. The third of the following is a true statement.
- D. The fourth of the following is a true statement.

7. The seventh of the following is a true statement. Which one is it?

- A. The first of the following is a true statement.
- B. The second of the following is a true statement.
- C. The third of the following is a true statement.
- D. The fourth of the following is a true statement.

- 4 -

22. White light is made up of
- A. three colors
  - B. one color
  - C. no colors
  - D. seven colors
23. Rainbows are caused by raindrops acting as though they were
- A. lenses
  - B. magnets
  - C. prisms
  - D. mirrors
24. A surface that absorbs all the wave lengths in the light which strikes it is
- A. white
  - B. black
  - C. gray
  - D. colorless
25. Which of the following statements is true about the color of ordinary sunlight?
- A. it is yellow in color
  - B. it is orange in color
  - C. it has no color
  - D. it contains all colors
26. Why is the flash of a distance explosion seen before the sound of the explosion is heard?
- A. the sound has farther to travel than the light
  - B. air absorbs sound and reflects light
  - C. light waves travel faster than sound waves
  - D. the eye is more sensitive than the ear
27. A clear pane of glass does not cause a shadow when light shines through it because
- A. light is reflected as it strikes the glass
  - B. the speed of light is less in glass than it is in air
  - C. light travels in straight lines
  - D. most of the light passes through the glass
28. On a warm, sunny summer day the surface of a dry concrete highway may appear to be wet in the distance. What causes this appearance?
- A. there is considerable moisture in the air even on hot summer days
  - B. the bending of light rays by hot air near the highway produces the same effect as reflection from a surface of water
  - C. light rays that strike the concrete at a small angle are almost completely reflected
  - D. little particles vibrating in the concrete give the appearance of water ripples

Age	10
Gender	50
Marital status	25
Education	15
Income	10

Table 2. Summary of data for the next 100 cases.

Age	10
Gender	50
Marital status	25
Education	15
Income	10

Table 3. Summary of data for the next 100 cases.

Age	10
Gender	50
Marital status	25
Education	15
Income	10

Table 4. Summary of data for the next 100 cases.

Age	10
Gender	50
Marital status	25
Education	15
Income	10

Table 5. Summary of data for the next 100 cases.

Age	10
Gender	50
Marital status	25
Education	15
Income	10

Table 6. Summary of data for the next 100 cases.

Age	10
Gender	50
Marital status	25
Education	15
Income	10

Table 7. Summary of data for the next 100 cases.

Age	10
Gender	50
Marital status	25
Education	15
Income	10

Table 8. Summary of data for the next 100 cases.

Age	10
Gender	50
Marital status	25
Education	15
Income	10



- 5 -

29. What does a light year measure?
- A. the distance between two bodies in space
  - B. the time it would take a rocket to travel to Mars or another planet
  - C. the brightness of light during daytime hours
  - D. the amount of light that the earth receives from the sun in one year
30. When observed from the bank, a post sticking up out of a clear stream appears to be bent. Why is this so?
- A. light travels faster in water than in air
  - B. light is reflected when it strikes the water
  - C. light is absorbed by the water before it reaches the bottom of the stream
  - D. light is refracted as it passes from air to water
31. Rough surfaces reflect light
- A. at right angles
  - B. curved lines
  - C. one direction only
  - D. many directions at once
32. A concave lens is used to
- A. spread light waves apart
  - B. break up white light into several colors
  - C. bring light waves close together
  - D. shorten the length of the light waves

1. The first part of the report is a general introduction to the subject of the study. It discusses the importance of the problem and the objectives of the research.

2. The second part of the report is a detailed description of the methods used in the study. It includes a discussion of the experimental design, the data collection procedures, and the statistical analysis techniques.

3. The third part of the report is a presentation of the results of the study. It includes a discussion of the findings, a comparison of the results with previous research, and a conclusion about the significance of the study.

4. The fourth part of the report is a discussion of the implications of the study. It includes a discussion of the limitations of the study, the strengths of the findings, and suggestions for future research.

APPENDIX E.

ORIGINAL DATA



## KEY FOR ORIGINAL DATA

Variable	Description
1.	Identification number
2.	Treatment: 1=100% K of R, 2= $33\frac{1}{3}\%$ K of R
3.	Sex: 1=Male, 0=Female
4.	Lorge-Thorndike (3A) Verbal IQ
5.	Lorge-Thorndike (3A) Non-verbal IQ
6.	Age in months
7.	Socio-economic status (Blishen)
8.	STEP Science (4A) Raw Score
9.	Time spent on Sound (min.)
10.	Time spent on Light (min.)
11.	Dependency Scale score (1st. admin.)
12.	Dependency Scale score (2nd. admin.)
13.	Errors reported on Sound
14.	Errors reported on Light
15.	Classroom
16.	Sound- Pretest
17.	Light- Pretest
18.	Sound- Immediate Post-test
19.	Light- Immediate Post-test
20.	Sound- Retention Post-test
21.	Light- Retention Post-test



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Chapter VI

Chapter VII

Chapter VIII

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Chapter XVIII

Chapter XIX

Chapter XX

Chapter XXI

Chapter XXII

Chapter XXIII

Chapter XXIV

Chapter XXV

Chapter XXVI

Chapter XXVII

Chapter XXVIII

Chapter XXIX

Chapter XXX

## ORIGINAL DATA

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1	2	0	122	111	125	48.2	45	105	140	47	49	7	11	1	9	6	13	16	15	19
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27	2	1	110	96	141	47.2	36	105	90	28	34	13	2	1	12	6	12	12	10	15
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32	1	0	127	123	132	63.5	45	105	135	32	41	9	14	2	9	7	18	15	21	16

\*Indicates incomplete data

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ORIGINAL DATA

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
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52	1	1	136	136	135	62.2	50	105	130	41	40	1	8	2	10	17	19	25	21	25
**53	2	1	90	76	146	40.8	35	110	75	31	34	1	0	2	9	8	9	5	6	9
54	1	1	121	123	130	64.7	50	100	85	35	43	2	3	2	11	11	14	17	18	19
55	1	1	103	102	137	43.6	45	80	80	41	40	1	2	2	11	11	12	13	13	11
56	1	1	96	88	144	57.7	24	110	95	23	25	13	7	2	10	9	6	5	7	7
57	2	1	89	87	144	42.8	33	80	115	32	28	17	21	2	13	8	10	12	9	4
58	1	1	95	81	132	41.6	28	85	100	40	40	6	0	2	5	6	11	11	9	12
59	1	1	88	80	146	48.2	18	85	115	38	41	1	0	2	7	12	7	8	9	9
60	2	1	104	104	146	41.6	30	80	80	32	37	1	0	2	11	6	7	8	13	5
61	2	1	138	118	131	57.7	50	100	100	39	44	0	0	2	12	14	18	22	19	24
62	1	1	88	61	147	41.6	19	135	95	36	38	24	17	2	4	9	9	12	13	11
63	2	1	127	123	130	57.7	45	80	90	33	45	1	4	2	10	11	17	21	16	20
64	1	1	141	119	123	57.7	34	75	90	29	40	2	0	2	9	10	13	12	16	14

\*\*Indicates subjects randomly deleted from the sample

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